# JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

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## EDITORIAL NOTES.

### The Residuals Inquiry Starts.

UNLESS anything unforeseen occurs, by the time this issue of the "JOURNAL" is in the hands of subscribers, the inquiry by the Joint Committee of the House of Lords and House of Commons will have commenced in Committee Room A. The first sitting is appointed for to-day, when the Chairman will be elected, and the course of procedure determined. The exact lines that the latter will take are not at the moment of writing very clear. The gas industry are, in effect, in the position of appellants against acts performed in the current session of Parliament; and it was at the instance of the gas industry that the inquiry was granted—its granting being at the same time a recognition by both Houses of Parliament that the industry really felt they had a legitimate grievance in regard to the course of events in this matter, and a recognition that there possibly exists some ground for the grievance. Whether the gas industry will be called upon to open the proceedings we do not know. The Committee may, of course, resolve that the Alkali Manufacturers' Association should be regarded as, *de novo*, petitioners for the imposition of restriction upon the gas industry, and for the placing in the hands of the chemical manufacturers an unrestricted control of the markets for residual products. Then they will be called upon to open with their case. The Committee have plenary discretionary powers in the conduct of the inquiry. The reference to them is "to consider whether any, and (if any) what, "restrictions should be imposed on gas authorities with respect "to the purchase and manufacture of the residual products "resulting from the manufacture of gas by other gas authori- "ties, or of other chemicals." Leave has also been given to the Joint Committee to hear parties interested, by themselves, their Counsel, agents, and witnesses, so far as the Committee think fit. We are now in the midst of a fight for free trade in the residuals of the gas industry, and against (for the gas industry) a crippling power that the chemical manufacturers seek to have placed in their hands. In last week's issue (p. 419), reference was made to the five members of the House of Commons who have been appointed on the Joint Committee. The noble Lords who will represent the Upper House are: Earl Craven, Lord Braye, Lord Howard de Walden, Lord Plunket, and Lord Inchcape.

### "Shadowgraph" Method of Testing Gas-Fires.

To the technical progress of the gas industry contributions are welcomed from any quarter, for upon that progress must rest the commercial status which the industry will progressively reach, as well as the permanent maintenance of its commercial interests. Gas heating is to-day a potential factor in the commercial situation of the industry; and the higher the technical progress that can be made in that direction, the greater and faster will be the commercial progress in this particular line, and the greater the benefit to the community through the promotion of more wholesome conditions of the atmosphere. The gas-fire has to be regarded as a means to an end. That means it is desired by everyone shall attain the utmost possible efficiency both thermally and hygienically; and those attributes can be best and permanently realized by constant care, which care necessitates continuous and reliable tests. The constancy of testing, and the application of tests in more quarters than that of the makers of the fires, must of necessity have relation to the facility with which tests can be applied. It was partly on this ground, and partly owing to an investigation that had been made over several hours, that last July there was introduced to the notice of our readers, with an indication of our commendation, the new hygienic test for gas-fires (known as the "Shadowgraph" test) that had been devised by the technical staff of the Davis Gas-Stove Company. We anticipated as not at all improbable that, for the purpose, the lines of that test would be (if not positively, by implication) both ridiculed and termed fantastic, without thorough examination by the critics, and merely on the ground that it was contrary to any test—chemical in some cases, and of a more or less rule-of-thumb order in others—previously applied in the works of gas-fire makers, or in the testing-rooms of gas undertakings. What was anticipated by us came to pass.

We have, however, now arrived at a point where those who have tried to depreciate the test and what the firm in question have done in this connection, have to face the results of an independent investigation of the "Shadow- "graph" system of testing for hygienic efficiency by one whose qualification for such work, and whose *bona fides*, are beyond question in the gas industry. Unreservedly, the Davis Gas-Stove Company invited Mr. W. J. Atkinson Butterfield, M.A., F.I.C., Assoc.Inst.C.E., to carry out a thorough investigation of the test; and they placed at his disposal and under his personal control and that of his assistant (Mr. F. L. Bassett, B.Sc., A.I.C.) all the facilities which they possessed for the research that he willingly and interestedly undertook. Perhaps there is no one in the whole country who does more analytical work in connection with the air of premises of various kinds, and in which diverse operations are conducted, than Mr. Butterfield; he therefore stands in a pre-eminent position in this regard. In an article in other columns, Mr. Butterfield explicitly describes the nature of the investigation and determinations that he made; and his contribution is accompanied by tables and diagrams the technical value of which will be freely and widely recognized. In view of the conclusions at which the investigator has arrived, it is for those who have in any way attempted to belittle the "Shadowgraph" system of testing either to admit they were in error and drew premature and untenable conclusions, or face Mr. Butterfield's case and endeavour to shatter it by a case showing where (if anywhere) he has erred, and where his conclusions are at fault. This is a matter of technical interest, and not one to be dismissed by dogmatic assertion or pure assumption.

The research that is described in the article before us is, we venture to say, of classical order, and will be regarded as of immense value to the gas-fire and gas-supply industries, for the information it contains, and for the useful data that Mr. Butterfield has compiled from his studious research. Upon being the means of publishing this information, we congratulate the Davis Gas-Stove Company; and we compliment them further upon the result of the investigation, which more than justifies the claims that they originally made for the reliability of their test. The article discusses completely the principles involved in the application of the test, and gives the findings from the experiments that were made, as well as from the control tests. Nothing it is seen was left to chance, and everything was duly checked. The principles underlying the test are discussed, and are found to be theoretically sound; the indications of the test are submitted to chemical check tests, with the result of an abundant practical confirmation of theory. As Mr. Butterfield succinctly describes it, the test depends on the condensation on a cooled plate of some of the water vapour which the products of combustion of town gas contain. The right temperature for the plate must obviously lie between the dew-point of the air and that of the products of combustion (there is ample difference between the two for advantage to be taken of it for distinguishing air from flue gas); the plate itself must have a capacity for maintaining the requisite temperature during the time occupied in making the test; and the plate too must accurately fit the canopy of the fire under test. All these conditions are inquired into; and they are all complied with. With the most exacting tests that he could apply, the investigator has come to the conclusion that it is impossible for any products of combustion to escape under the canopy without detection by the cooled plate, and the detection of products of combustion just by the edge of the canopy means that they are products (before dilution with the air of the room) of precisely the same composition as the flue gases. The densest

opacity where there are escaping products occurs at the bottom of the plate near the edge of the fire canopy; and as dilution and diffusion take place, so the indications upwards on the plate tend to diminish in intensity. And what happens on the plate is precisely confirmed by the air samples taken and submitted to chemical test.

As the article descriptive of the research proceeds, we have at each step Mr. Butterfield emphasizing with additional strength the view that here we have a rational and positive test for the hygienic efficiency of gas-fires, and therefore a valuable test. In one place, we have him saying that, if applied with reasonable care, it should never fail to detect even a small escape of the products of combustion from the front of the canopy of a gas-fire; and it should never indicate an escape of products where there is none. It has the great advantage over the other methods of testing of which Mr. Butterfield has knowledge, that it avoids the difficulties of sampling. These difficulties are very great in such cases, owing to the stratification of the heated air currents. That is one pronouncement; and in another place, for reasons stated, he says that the test appears to him to be inherently more trustworthy than other modes of testing for the escape of products of combustion from the front of gas-fires. Again, he remarks, the sensitiveness of the test is as high as its underlying principles suggest should be the case. What more need be said? These are the conclusions of a highly scientific research, against which any mere postulatory statements will not command much respect. With the results of this investigation, the Davis Gas-Stove Company can confidently leave the question of the validity of the test to the judgment of the technical men of the gas industry. Very little doubt exists in our mind that, with this testimonial to its simplicity, soundness in principle, and reliability, the "Shadowgraph" method of testing will obtain adoption in testing-rooms farther afield than the place of its origin, including the laboratories of many gas undertakings. The more places the better; for the interests of the gas industry will be best served by every type of gas-fire that is sent out being above suspicion.

This article must not conclude without acknowledging the indebtedness of those who are, and may hereafter be, engaged in gas-fire research to Mr. Butterfield for having gone beyond the limits of the reference to him, and including in the article prepared specially for our columns a table, diagrams, and formulæ which (with the explanatory text) will be found of very general utility. We are promised further interest in a second article, in which the author will deal with some points suggested by his investigations which have a bearing upon the wider question as to what are the circumstances, if any, in which a gas-fire that allows products of combustion to escape under its canopy may legitimately be considered as conforming to the requirements for a hygienic means of heating at the present day.

## Earlier Street Lighting Tests in Manchester.

It is said that in the multitude of counsellors there is wisdom. The Lighting Committee of the Manchester Corporation will doubtless find only confusion, and little guidance, in the multitude of tests that have been made in connection with the glaring trial flame arc lamps in Portland Street, and the admittedly defectively installed high-pressure lamps (which, through the defect, are receiving a pressure too low for their full effective working) in Princess Street. Previous to Mr. Jacques Abady and Mr. Haydn Harrison being called in to report on the street-lighting experiment, Mr. S. L. Pearce, the Chief Engineer of the Electrical Department, had been making numerous tests of the lamps, and had presented reports to his Committee on the subject, together with a sheaf of curves and diagrams, the meaning of which to laymen in these matters must be of a somewhat abstruse order. In his main tests, Mr. Pearce takes a horizontal plane 5 feet above the ground level, so getting nearly 2 feet nearer to the lamps than Mr. Haydn Harrison, and nearly 4 feet nearer to them than Mr. Abady. But at the same time he *calculates* illumination figures at the 3 ft. 3 in. level. Therefore, if the members of the Lighting Committee consider Mr. Pearce's report in conjunction with the other two, they will be more confounded than ever. Mr. Pearce, when he made his tests, had not, we opine, discovered that the high-pressure lamp connections (locally fitted up) were depriving the high-pressure lamps of the measure of pressure to which they are entitled in order to give the efficiency which is easily obtained elsewhere. But now he knows that he was testing a defective high-pressure installation, his illumination figures for the high-pressure lighting compared with the illumination figures from the ghastly demonstration of glare in Portland Street will surely appeal to him as being even more eloquent than he first imagined them to be.

Before dealing with the illumination tests, there are some noteworthy general features in Mr. Pearce's report which indicate, we think distinctly, that, at the back of his mind, the feeling was established that, for purity and excellence of illumination, the defectively suspended high-pressure gas-lamps were the superior of the flame arc lamps. We see this in the course of the experimental events; we see it too in various statements made in the report. Concealed in his words, too, we detect an acknowledgment that such a climate as that of Manchester really demands the illuminant that will render the best duty under the most abnormal conditions of the atmosphere. But there is the dignity of the Electricity Department to be considered; that must be allowed, according to electrical doctrine, an ascendancy over the interests of those who have to use the streets. Mr. Pearce recognizes the vagaries of the Manchester climate. These vagaries, he says, occasioned "much inconvenience" during the tests, "and work had frequently to be abandoned just at the time "when successful results were being obtained," which phrase indicates that there were times when unsuccessful results were being realized. But notwithstanding the "vagaries" which caused the stoppage of the photometrical work as well as "much inconvenience," "no favourable opportunity" at the date of the report had arisen "for making any com- "parative tests of the penetrating power of the Portland "Street and Princess Street arc and gas lamps under ab- "normal conditions." Yet Mr. Pearce proceeds to express the opinion that the Portland Street lights showed up extremely well during a "recent dense fog." Was not that a favourable opportunity for making comparative tests?

In the next place, we must join issue with Mr. Pearce over certain remarks of his which appear to be contradictory, and are amusing in their contradiction—more particularly when brought into comparison with official tests of high-pressure gas-lamps elsewhere. Mr. Pearce, if he is a student of these matters, must be well aware that, when there is delivered on the inlet side of a high-pressure lamp governor a pressure in excess of that to which the governor is set, a constancy of illumination can be more easily attained than by any other means. If Mr. Pearce knows this, if he is aware of the results of the stringent testing in Westminster and elsewhere by the officers of the local authorities, if he is cognizant of the fact that various illumination authorities have admitted that the steadiness of the illumination of high-pressure lamps enables them to make more reliable tests with them than they are able to do with flame arc lamps, he ought not to have written, without qualification and explanation, that in the case of the gas-lamps "the daily variation is so great that it is extremely "difficult even to strike an average;" and further "it is "not at all unusual for the candle power of a lamp to vary "nearly two to one, and it is almost practically impossible "to ever obtain the same result for one lamp on two con- "secutive days." Presuming this was so with these Manchester gas-lamps, if Mr. Pearce was aware, when he wrote the report, of the efficiency that is being secured elsewhere with the same type of high-pressure lamps, then all we can say is that we should have applauded a reference by him to the fact in the report. But how are we to reconcile with what we have quoted above a further statement by Mr. Pearce. He says: "The light of the gas- "lamps is somewhat *steadier* than that of the arc lamps, "although the difference is hardly discernible to the naked "eye. But it is very noticeable on the photometer; and "consequently it was very much easier conducting tests on "the gas-lamps than on the arc lamps." Now, which of these cited statements is Mr. Pearce prepared to defend? They seem to be at variance one with the other. But as the latter is consistent with the truth as to steadiness, the testimony is welcome from an electrical source to one of the factors that go to make for quality in illumination. We proceed to read that, "although the gaslight is appre- "ciably steadier, there are nevertheless very considerable "cyclic variations in the candle power which are clearly "apparent to the most casual observer. This effect is "presumably due to variations in the gas pressure." Will Mr. Pearce kindly point out in this connection where, in a high-pressure gas system, there is any mechanical or other

reason for variation in pressure, presuming the installation is properly made? We confess, with a large experience of gas lighting at high pressures, that we do not know where or why there should be such variations under correct conditions of installation and methods of working. However, perhaps Mr. Pearce will enlighten us.

While there are these discordant statements as to the steadiness of the light from high-pressure lamps, there are indications that Mr. Pearce is painfully conscious of the defects of arc lighting in this regard. He states that "observations and tests on the flame arc lamps confirm a *reasonable* permanency of the candle power—that is to say, with the exception of the periodic variations when the carbons are feeding, and the *slight* flickering effect." Either Mr. Pearce or ourselves suffer from some visual defect, or we give a different degree of meaning to the qualifying term "slight;" for with the plain glass globes, very modestly obscured at the bottoms, used with the Portland Street arc lamps, the flickering effect is much intensified. There is a considerable amount of testimony from illuminating engineering sources as to the difficulty of testing flame arc lamps owing to their inconstancy; and long before this Manchester business cropped up, Mr. Haydn Harrison was pointing out the large difference there is between the nominal and the useful candle power of flame arc lamps. In addition to this, there is another admission unfavourable to the flame arc lighting, and favourable to high-pressure gas lighting. Mr. Pearce says that "the only objectionable feature" of the flame arc is "the rather pronounced shadow under the lamps." But in the case of the Princess Street high-pressure gas-lamps "a noticeable feature is the *entire absence* of shadows under the lamps." Yet another visual discrepancy between ourselves and Mr. Pearce is the "absence of glare" with the Portland Street lamps. Perhaps the Electrical Engineer of Manchester is one of those persons who, accustomed to such lighting, do not experience (as Mr. Haydn Harrison would say) the same "psychological" effects—to say nothing of physiological effects—from glare as do those numerous other people who are not so accustomed, who are not electrical engineers, and who are in the majority. However, taking Mr. Pearce's report on the various points affecting quality of illumination, we claim that it distinctly places the high-pressure gas light in a position superior to the flame arc light. In another article, we will deal with the measurements as given in the report of the light from the lamps.

## Vitality.

A MATTER of somewhat frequent comment has been the vitality of the gas industry. An extraordinary example of this is found in the speech of Mr. J. Horsley Palmer, at the meeting of the Imperial Continental Gas Association, last Tuesday. The Association, as is well known, carry on their operations at several important centres on the Continent. Last year the Vienna station was taken over by the Municipality, or rather the supply to the suburbs which had been served by the Association passed into the hands of the Municipality. During the half year ending June 30, the increase in gas consumption, taking the aggregate of the whole of the stations, was 5½ per cent.; but, in the first half of the current six months, the increase has been at the average rate of 9 per cent. With this good advance in business, although Vienna was lost only last year, the Association have already, by their expansions of business elsewhere, recouped 90 per cent. of the loss of consumption occasioned by the transfer. There is only therefore 10 per cent. more to make up to establish the *status quo* in gas consumption. This speaks well for the efficacy of the propaganda methods, and the energy of the staffs, at the other stations. But there is another point. It is that the decreased average consumption per consumer that has been noticed for some years, through the connection of prepayment consumers, has now about come to an end—whether permanently or not remains to be seen. Prepayment consumers are still being connected up at an excellent rate; but it is the energy in cultivating the heating and cooking load, and the use of gas for such domestic purposes as ironing and in industrial operations, that have stayed the descent in the line of the average consumption curve. Of course, the conditions are somewhat different on the Continent from what they are in this country. Business in gas heating and cooking was not developed there with such vigour as here years ago; and consequently the gas undertakings there have had that line of business upon which to fall back in more recent years to bring about a stoppage of the descent of the line of average consumption per consumer through the incoming of prepayment customers. The large development that there has been of late years in the gas-fire business in this country should contribute to the raising of the average consumption figure, though, being a seasonal consumption, and not then a permanent one through the comparatively high temperatures frequently ruling now during the winter months, it cannot be hoped that the effect on the average will for a time make any very substantial showing. Touching upon the subject of coal, Mr. Palmer made it clear that he and his colleagues—in common with other large purchasers of coal—feel very strongly regarding the extent to which the coal-owners have pushed-up prices, following upon the abnormal conditions produced by the coal strike.

## Space-Saving Carbonization.

IT is a claim—and now a largely substantiated claim—of the vertical retort system of carbonization that considerably more gas can be made by it on a given ground space. This applies not only to one system, but to all. The vertical erection of the retorts, and the fact that charging is performed at the top and discharging beneath the retorts, enable them to be packed in a suitable building without the charging and discharging floor space required by their precursors. This ability to obtain by the new systems a larger production on the old ground space has caused more than one engineer within our knowledge to defer consideration of further land acquisition, or rather the beginning of works on a new site. In other columns this week, there is described the new installation of Woodall-Duckham continuous retorts at the Smethwick Corporation Gas-Works. What the Engineer (Mr. Vincent Hughes) has done there has been to transform the fabric of his old horizontal retort-house by raising the walls by rather more than 30 feet; and, by way of commencement, he has displaced four horizontal beds of eights by six beds of four vertical retorts, 25 feet long. These six beds, by being placed in two parallel lines of three, occupy practically the whole of the area that was formerly taken up by the four beds of horizontals, including the ground space required by them for the charging and discharging operations—the clinkering-stage being between the two rows. The four superseded horizontal beds were capable of contributing 400,000 cubic feet of gas per day to the works' output; but the verticals which have now taken their place turn out, with ease, 1,250,000 cubic feet, which is more by 350,000 cubic feet than the nine beds of horizontal retorts were previously able to do. The intentions of Mr. Hughes are to continue the transformation of the horizontal beds to verticals in the early part of next year. We do not know how many settings of verticals he anticipates getting into the remainder of the house now occupied by five beds of horizontals. But supposing he only puts in six more vertical settings—thus duplicating the present installation—this will mean an easy productive capacity for the house of 2,500,000 cubic feet, as compared with 900,000 cubic feet on the same superficial space with the horizontal beds. This is a point which cannot be overlooked when it comes to the consideration of increased productive capacity, and the issue is a direct one between adopting verticals or starting works on a new site.

### Importance of Pressure for High-Pressure Lamps.

The importance of delivering to every high-pressure gas-lamp the degree of pressure for which it is regulated, in order that each lamp shall give its proper duty is a point that has been frequently made in these columns. Any lapse in this respect is fatal to the realization of full efficiency. The initial pressure must be such that the most distant lamp on the system does not suffer by draughts on the mains between the compressor station and the lamp, but has delivered to it a pressure above that to which it is governed. In the West-end of London, we believe that the initial pressure is somewhere between 80 and 90 inches; and no one can say that the most remote lamp in the area of high-pressure lighting does not get its proper degree of pressure, and that the full lighting efficiency is not maintained. We recently heard that the high-pressure system of gas lighting had become very popular in Leicester; and that tradesmen have gone

in strongly for 1000-candle power lamps at a cost of £5 per lamp. In connection with this development, Mr. Hubert Pooley, the Engineer and Manager of the Gas Department, informs us that they have been carrying out tests on 1000-candle power lamps, working with initial pressures of 90 inches at the compressor station. The gas is of 14½-candle power; and in the tests uncollodionized silk mantles were used. The consumption per lamp is 17 cubic feet per hour; and the average illuminating power of the lamps is 997 candles per 1000-candle power lamp. This is an efficiency of 58·6 candles per cubic foot of gas—near enough, in all conscience, to the makers' nominal claim of 60 candles. Mr. Pooley is so satisfied as to the ability to maintain the lamps in the region of this figure that he is prepared to guarantee an efficiency of 50 candles—keeping the efficiency above in hand as a margin of safety.

## Gas Regulation in New South Wales.

The Bill for the regulation of gas companies in New South Wales, to which reference has already been made, was under consideration by a Committee of the Legislative Assembly on the 11 and 12th of September; and it will be seen from what appears elsewhere that certain noteworthy amendments have been made in the measure. As the Bill was introduced, the standard price of the Australian Gas Company was put at 3s., and the dividend was cut down to 4 per cent. These figures have been amended to 3s. 3d. and 10 per cent. The latter concession was made rather reluctantly, as the Minister in charge of the Bill thought the rate proposed would have been a reasonable return to the investor. New capital is to be issued at the usual rates of 7 and 5 per cent., according as it is ordinary or preference. Gas is to be supplied of 15 (not 16) candle illuminating power, and of 500 B.Th.U. calorific value—figures which will apply to all companies. Meters are to be tested by a Government official before being sent out.

## Prepayment Meter Thefts.

This matter is intermittently brought to the surface by public reference. It was raised by Mr. Joynson-Hicks in the House of Commons last week; and his question to the Home Secretary brought forth some information as to the results of a conference on the subject, last July, between the Home Office and representatives of the London Gas Companies. The London Magistrates are constantly complaining of the number of thefts from prepayment meters that are brought before them; and they allege, and not without some cause, that the flimsiness of some of the money-boxes of prepayment meters is a standing temptation to crime. The reply that Mr. Joynson-Hicks received shows that the London Companies are willing to do their reasonable part in mitigating the trouble on the lines that are commonly advocated. No new ones are suggested. The Companies have promised to gradually introduce stronger meter money-boxes and locks into the districts where the larcenies chiefly occur; in the case of tenement houses, they are willing to place the meters inside the tenant's room; and more frequent collections is to be another mode of preventing thefts. The Home Secretary hopes that this agreement will result in the mitigation of the difficulty. There is no doubt that it will. The processes described to accomplish the desired end have had their effect in the past where applied. We remember the dotted map that the late Mr. Alfred Colson once prepared of the prepayment meter robberies in Leicester; and how, by the adoption of a stronger money-box in the areas which mainly received the attentions of the thieves, the spots on the maps became fewer year by year. It is not a large total sum that the Companies lose from the money-boxes; their chief loss is in the expense of repairing the damage occasioned by the robbers.

## "Death from Misadventure."

This is the verdict returned in the case of two victims of electric baths recently in West London. About three weeks ago the Coroner for the district inquired into the death of a woman which occurred in an electric bath. Now there has been occasion to investigate the cause of the death of Mr. John C. Moreton Thompson, L.L.D.; and our direct interest in the affair is only concerned with the question of voltage. Mr. Thompson was regarded by his medical adviser and his friends as a healthy man; and all that could be found wrong with him were merely signs of heart and aortic disease. It appears that while he was in the bath, and the attendant was temporarily absent, "the resistance lamp on the switchboard shortcircuited," and the full pressure of the electric current from the main—240 volts—passed into the bath. Deaths through electrical current at ordinary district voltages are not by any means unknown. The Chief Inspector of Factories has reported some, and intelligence has from time to time been received of similar occurrences in private and business premises. All people are not aware whether or not they have slight disease of the heart or aorta; and perhaps the circulation of the information concerning this fatality will induce people to exercise more care before having anything to do with electrical energy, even at ordinary district pressures. The worst of these affairs is that no warning is given to the victim—either by smell or in any other way.

## Loans of Borough Councils.

From a perusal of certain sections of the many figures contained in the first portion of Part V. of the Annual Local Taxation Returns for the year 1910-11, which deals with the accounts of the 325 borough councils (other than the Metropolis), some interesting particulars can be gathered with respect to the nature and total of the outstanding loans of these bodies at March 31, 1911. In the previous year, the total of these outstanding loans was nearly £252,000,000; and this amount has since risen to £255,500,000—which compares with £246,500,000 for the year 1907-8, and £232,000,000 for 1904-5. To be put against the first-named sum, however, there is shown in the accounts an amount of about £18,500,000 standing to the credit of sinking funds, loan funds, and redemption funds applicable to the repayment of these loans. As is customary in these statistics, the accounts of four classes of reproductive undertakings are separately dealt with; and the loans outstanding in connection with these amount to £126,500,000, or nearly approaching half of the total. The undertakings and the amounts of the loans are: Tramways and light railways, £22,568,895; water supply, £63,168,694; gas-works, £19,217,134; and electricity supply (including indistinguishable items for public electric lighting), £21,509,680. These figures are very much the same as they were twelve months earlier, with the exception of water supply, to which item about £1,000,000 has in the interval been added. Since 1907-8, the loans on borough council gas undertakings have decreased by about £80,000; while those connected with waterworks have gone up £2,500,000, and for electricity supply nearly £1,000,000. The other purposes for which large sums of money are owing by the borough councils include £28,000,000 for public roads and streets, £21,250,000 for sewerage and sewage disposal works, and £20,750,000 for education.

## Profits and Losses.

Another feature of these annual abstracts of the accounts of borough councils is the information given with reference to the profits or losses resulting from the operations of the four classes of reproductive undertakings already referred to—tramways and light railways, and gas, water, and electricity concerns. On the receipts side of the accounts, is an item of amounts transferred to other accounts of the councils in relief of rates; and for the undertakings mentioned, in the year 1910-11, the total transferred was £1,174,286. This is £150,000 more than was handed over in the previous twelve months—which sum, in its turn, was £88,000 above the amount transferred in 1908-9. Then, again, on the expenditure side there is an item of amounts transferred to other accounts of the councils to make up deficiencies in revenue of one or other of the "reproductive" undertakings; and the total of this on the present occasion is £393,398, which compares with £338,302 for the preceding year, and £331,988 for 1908-9. Of the total amount of profits transferred in aid of the rates, gas undertakings are responsible for nearly one-half—the figure being £526,018, against £490,470 for the preceding year. The total amount transferred to meet deficiencies in revenue on gas undertakings, too, was only £1068—a sum which is not worth mentioning side by side with the transfers needed in different cases for the other three classes of concerns. There were fifteen cases in which sums of £10,000 or over were contributed by gas undertakings owned by borough councils in relief of the rates. In regard, however, to water undertakings (which, of course, are not primarily "run" from a financial point of view) the case is far different; for the £136,851 profits realized compare with total deficiencies which had to be made good of £268,298. As to the electricity undertakings, it is seen

that the profits transferred by borough councils in relief of rates amounted to £152,259, while the deficiencies falling to be made good totalled £31,439.

### Engineering Training.

Much of the Presidential Address of Mr. R. Elliott-Cooper to the Institution of Civil Engineers, a few days since, was occupied by a survey of the considerable prospects for engineering work abroad; and there was also much in the deliverance regarding the public appointments abroad for the juniors. The juniors in the engineering world want encouragement of this kind, and that supplemented by something of the material nature supplied by actual appointments. Prefacing these parts of his address, the President directed attention to the trite subject of engineering training. He agrees that it will avail little to lay down standards of knowledge suited to form the basis of engineering training, and to devote careful attention to the means of testing the possession of such knowledge, unless at the same time the needs of those who had proved their fitness in this respect were recognized and provided for in the matter of opportunities for obtaining practical training. It is this side of an engineer's training with which most fault can be found. Facilities for obtaining instruction in, and knowledge of, the science of engineering have been vastly expanded; but there is still in some engineering works a disinclination to open the doors for the practical side of their training to those who are learners. This disinclination is not so widespread as it was once upon a time; and we have it from a student of these matters that, since the conference held in 1911, under the auspices of the Institution, on the general subject of engineering training, there has been a marked change in this regard, and many additional engineering works have laid themselves out for giving a practical training to engineering youths. We are glad to hear this, as at one time there were doubts in mind as to whether any practical good would result from the conference.

### Water Purification by Excess Lime.

At a recent meeting of the Metropolitan Water Board, the Water Examination Committee reported that, in view of the advantages claimed by the Director of Water Examination (Dr. A. C. Houston) for the "excess lime" method of purification—notably its usefulness in time of flood, its capacity to quickly render an initially foul water absolutely safe bacteriologically, and its virtual increase of the yield of the sources of supply by rendering them always fit for abstraction—they were of opinion that certain experiments suggested would be of great practical value to the Board. The Committee recommended that an estimate of £600 be approved and that they be authorized to incur expenditure not exceeding this amount in experiments to demonstrate the efficacy or otherwise of the "excess lime" method described by Dr. Houston in his eighth report upon research work. The Committee had been informed by the Deputy Chief Engineer (Mr. J. W. Restler, M.Inst.C.E.) that, subject to the concurrence of the Works and Stores Committee, the filters at Hanworth could be placed at their disposal for the purpose of these experiments. A long discussion took place on the subject, and eventually the Committee's proposal was referred back for further consideration.

**Illuminating Engineering Society.**—The first meeting of the next session of this Society will be held at the Society of Arts rooms, John Street, Adelphi, on Tuesday next, when Mr. L. Gaster will present a report of progress during the vacation, with special reference to his visits to the Continent and to the United States. It is also anticipated that novel and interesting apparatus of various kinds (including specimens from the collection of ancient lamps of Mr. J. W. Johnston) will be shown at the meeting. Mr. Haydn Harrison will describe a new illumination photometer.

**Doherty's Gas-Purifying Process.**—Mr. H. L. Doherty, of New York, has taken out a patent for the United States for a process of purifying coal gas. The following abstract of the specification appears in the "Journal of the Society of Chemical Industry." The crude coal gas is scrubbed with ammoniacal liquor containing a substantial proportion of hydrated ammonia, and the liquor is withdrawn and heated at a temperature below 200° Fahr., whereby most of the carbon dioxide and hydrogen sulphide absorbed from the gas are driven off, while the bulk of the ammonia is retained in solution. The liquor is then divided into two streams, one of which is cooled and used for scrubbing a fresh portion of crude gas, while the other is boiled to drive off free ammonia. This latter portion of the liquor is again divided—part being used to absorb ammonia from the gases evolved in the heating of the liquor from the scrubbers, and the rest to absorb ammonia from the coal gas which has already passed through the scrubbers.

## OBITUARY.

It will be noted with regret that, when addressing the proprietors at the half-yearly meeting of the Imperial Continental Gas Association last Tuesday, Mr. J. Horsley Palmer had to announce the receipt from Berlin of news of the death of Mr. ALFRED DRORY, who had for many years been the Engineer-in-Charge of the Association's large meter works in Berlin.

Mr. JOHN DURRANT, for many years Manager of the Isle of Wight Water-Works, was discovered last Tuesday evening dead in a chair at his house adjoining the works at Sandown. He was the first employee on the works when they were started, about half-a-century ago; and by his industry he had worked his way up to the managership. Deceased was in his eightieth year.

The death, on Monday, the 28th ult., in his seventy-eighth year, of Mr. JAMES TURNER RILEY, removes one who took a conspicuous part in the administrative work of Halifax, especially in connection with its gas undertaking. Mr. Riley entered the Town Council in 1872, and served the public on the Corporation for between 26 and 27 years, in the course of which period he was created an Alderman. He was Chairman of the Gas Committee, and during his tenure of the position he had to hold his own in the midst of unpleasantnesses existing between sections of the Council which will probably be in the recollection of some of our readers. Mr. Riley held strongly that, instead of appropriating large sums from the gas profits in relief of the rates, the benefit should be given to consumers, in cheaper gas. During his chairmanship, a Provisional Order was obtained authorizing the Corporation to supply electricity. The funeral took place on the 31st ult., and was attended by a large and representative gathering, betokening the respect in which the deceased was held in the borough.

## PERSONAL.

Alderman T. P. GRIFFITHS, who is to receive the freedom of Southport, in recognition of his public services to the town, extending over forty years, has been Chairman of the Southport, Birkdale, and West Lancashire Water Board since its formation.

Mr. THOMAS BERRIDGE, J.P., the Manager, Engineer, and Secretary of the Leamington Priors Gas Company, has been returned unopposed as a member of the Town Council. He is Vice-Chairman of the Chamber of Trade; and his cousin, Sir Thomas Berridge was formerly Member of Parliament for the borough of Leamington.

The Directors of the Newcastle and Gateshead Gas Company have appointed Mr. WILLIAM THIRLAWAY to the position of Chief Cashier of the Company, in place of the late Mr. Robert Telford, whose death was announced in the "JOURNAL" for the 24th of September. Mr. Thirlaway has been for nearly forty years connected with the Company.

We regret to learn that, owing to failure of eyesight, Mr. G. H. JACKSON is resigning the position of Working Manager to the Knighton Gas Company, after a service of ten years, during which time the Company's business has greatly developed. On Mr. Jackson's appointment early in 1903, no dividend had been earned for some time; but the Company are now able to declare a dividend of 7 per cent., and many economical improvements have been carried out in the works.

At their meeting last Tuesday, the London County Council adopted a recommendation of the General Purposes Committee, and promoted Mr. G. W. HUMPHREYS, M.Inst.C.E., from the position of Deputy Chief Engineer to that of Chief Engineer and County Surveyor when this post will become vacant by the resignation of Sir Maurice Fitzmaurice, C.M.G., at the end of the year. Mr. Humphreys was appointed to his present position in March last, having served under the Chief Engineer since the beginning of 1910.

On the invitation of Mr. T. A. Dunn, Chairman of the Stafford Corporation Water Committee, the members of the Town Council and officials attended at the Borough Hall last Wednesday, for the purpose of presenting to Mr. WILLIAM PLANT, the Borough Engineer, an album of views of the water-works, in recognition of his able services in connection with the extensions and alterations at the pumping-station at Milford. The album bore the following inscription: "Borough of Stafford Water-Works Extension. Souvenir presented to Mr. Wm. Plant, Assoc.M.Inst.C.E., Borough and Water-Works Engineer, by the members of the Water-Works Committee." Mr. Dunn, who presided, said the Committee were anxious to pay a compliment to Mr. Plant because of the entire success which had marked his labours in extending the water-works. For its size, the town had now a supply of water which was second to none in the country. Remarks having been made by the Mayor (Alderman E. W. Taylor) and others, Mr. Plant expressed his thanks for the gift; saying he should always look with satisfaction upon the works at Milford, and would prize the album as a mark of the appreciation of the Water Committee. The Milford works were first opened in March, 1890; and eight years afterwards the well was deepened by 10 feet. The latest extensions were completed in April last, and were noticed in the "JOURNAL" at the time. As a result, the yield has been increased by 55 per cent.

# THE BRITISH COMMERCIAL GAS ASSOCIATION.

### An Interesting Number of the Bulletin.

THE November number of the "Bulletin" of the British Commercial Gas Association, which was published on Saturday, is full of interest; and as it is, of course, printed for private circulation only, we take the opportunity of reproducing in full, for public perusal, two of the articles contained therein. One of these is on

### THE FIRST CONFERENCE,

BY THE PRESIDENT (MR. CORBET WOODALL).

Looking back upon the two strenuous days of our meeting in Manchester, I find occasion for unqualified satisfaction. That widespread good will result is beyond question; but if we had to count only the days themselves, with the friendly interchange of opinion and information, the idea of co-operation dominating all, the trouble and the cost would be repaid.

There was, to my thinking, an atmosphere about the meeting, difficult to define, but nevertheless perfectly obvious to all present, which carried the proceedings above the level of the mere commercial spirit. Nobody gave the impression that he was there for the immediate benefit of the particular undertaking in which he was interested, but rather for the purpose of supporting a public movement for the good not only of the gas industry as a whole, but also of the community at large.

Our kind hosts of the Manchester and Salford Corporations gave, at the outset, the keynote to our proceedings, by making it clear that the support they gave to the Association was not with the sole object of promoting the prosperity of gas, but with the higher aim also of ameliorating the lot of many thousands of workers in the crowded districts of Manchester—the improvement of the public health by providing the poor with a cheap means of cooking their food and of lighting and warming their homes, and incidentally by helping to drive the smoke fiend from the streets. It was good to hear Mrs. Cloudesley Brereton reiterate that her enlistment in the service of gas was due entirely to her enthusiastic interest in the public health movement.

As with the Manchester and Salford councillors and our Editor, so, too, with the representatives of gas undertakings and the manufacturers. All seemed delighted to be identified with an Association which, instead of being a mere profit-making instrument, had, without in any way losing its commercial character, promise of becoming a real power for good in the land.

I regard the character and organization of the meetings at Manchester as a pleasing forecast of what we may expect of the Jubilee Gas Exhibition to be held next year, and the spirit that animated all who were present as a happy augury of the support that may be looked for from all quarters for that event.

I am happy in having been priviledged to preside at this great gathering at Manchester, am proud of the spirit which pervaded it—a spirit which I believe will communicate itself to all right-thinking members of our great industry and render the duties of succeeding Presidents as agreeable as were my own. If there were any doubt on the subject before, it is now perfectly certain that the British Commercial Gas Association is a great success; and we cannot be too grateful to our friends in Manchester and Salford for setting the seal upon that success by granting facilities for holding our first annual conference in their midst, and helping so generously to make the conference worthy of the occasion. I venture to think that the time is not far distant when the support accorded to this national movement will be practically universal.

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The second appears under "Notes and News," and contains some remarks which (in view of what was said at Manchester about gas not attacking electricity) may be commended to our electrical friends, as a reminder of the fact that unfair attacks come not from the side of gas, but from their own.

### IS ABUSE ARGUMENT?

If electrical journalists want to win their cause with the general public, they had better cease sneering at the gas industry. This sort of cheap journalism only betrays envy, jealousy, and malice; and the public understand. Professional men, whether electric or gas engineers, and all business men most heartily despise it. Competition is good for all, and we have all to put up with it from cradle to grave, unless we are among the idle rich or the idle poor. But let us respect British traditions, and compete like sportsmen. The gas and the electric industries are rivals but not foes. A speaker at the recent British Commercial Gas Association Conference asked us to state that the Association is not intended to damage electric interests. Some of its members are, it is well known, in charge of municipal combined gas and electric undertakings. The British Commercial Gas Association has always refrained from abuse of our electric competitors. It has never been offensive to electricians; but it has often been driven to take the defensive by offensive attacks.

When "Electrical Industries" repeats the old, old story of "gas fumes," we will say nothing more offensive than that this is unworthy of a good type of journalism, as every electrical engineer knows there are no fumes given off by the modern gas-fire properly fixed. "Electrical Industries" talks about a lawyer with a bad case doing better often than one with a good case. This is a futile sneer at ourselves. We remind "Electrical Industries" of a well-known tradition in the law. The counsel who has no case abuses the plaintiff's attorney.

When this journal bewails that "the trail of the amateur is over everything their Committee has done," we discover that its sneer at the "smug satisfaction" of the British Commercial Gas Association means it is irritated because we employ specialists with success.

We are glad to admit that the "Electrical Review" and the "Electrical Times" practise a more worthy method of controversy. They praise the methods of gas experts, and admit in a gentlemanly way that while their rivalry is very serious, it is without hostility to the electrical industry. It recognizes that there is room in the social economy for gas as well as electricity.

Gas engineers believe that electricity cannot successfully compete with gas for cooking and heating; but to prove their case they severely confine themselves to scientific and economic facts. They are aware that educated public opinion will not be won over by abuse and exhibitions of trade and professional jealousy.

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The "Bulletin" also contains, among other matter, abstracts of the papers read at the conference, an illustrated supplement entitled "A Scientific Retrospect, from William Murdoch to Corbet Woodall," and an article on "Selling Gas," reprinted from the October issue of the "Advertising World."

# ELECTRICITY SUPPLY MEMORANDA.

**Electrically Ignored Lessons from Manchester—Silence!—Mary Desbrisay on Electric Cooking—Christmas Shop Lighting—Publicity Comparisons—Mr. Seabrook upon Competition and Municipal Trading—At the Home Office.**

WHERE gas is concerned, any crazy excuse, or the semblance of a success on the part of electricity, serves our electrical contemporaries as the occasion for a *feu de joie*. They have let off their little guns, with more or less vigour and noise, over the expert reports on the Manchester street lighting; but when their explanation of the cause of their joy is examined, it is found that they have kept from their readers the salient lessons of the reports. We are told that the reports will be classical ones for future reference. With this there is unadulterated agreement on our part. In future we may be often quoting them; in the battle between high-pressure gas and flame arc lights, the adherents of the modern high-pressure lamps will frequently have recourse to them. They will tell what our friends have refused to recognize about them—that, in the competition between these two forms of light, the candle power even of almost naked flame arcs is nothing to go by, seeing that much lower candle power high-pressure gas-lamps give approximately the same illumination in the streets. In other words [see Mr. Haydn Harrison's report], a 2970-candle power arc lamp (with a globe only slightly obscured at the bottom) gives a degree of illumination only "approximately equal" to a 1750-candle power high-pressure gas-lamp [see joint report], and a quality and steadiness of light much inferior to that of the latter [see Mr. Jacques Abady's report]. Our electrical friends, too, have made overmuch of the question of costs. They know right well from the experts' statements that the high-pressure lamps in this test were not doing half as well as similar lamps are doing elsewhere, owing to the fact that the equipment was made by those who manifestly did not understand the necessities. The compressor was right, the lamps were right; but if the house of Keith had had the insertion between the two of their own proved suspension and service gearing, the lamps would have imparted their full efficiency. Then what would have happened? The lighting under the existing conditions being "approximately equal," the arc lamps would have had to be doubled in number (all with plain globes merely slightly obscured at the bottoms) to realize approximate equality in lighting power. What about the costs then—costs electrically thinned-down to a shadow, costs that do not satisfy one of the two experts, costs that the other expert (it would seem) prefers not to discuss, and costs obtained, on the illumination power basis, by a brutal violation of the tenets that the new school of illumination engineers have set up for the worship and practice especially of electrical engineers. It requires a very strong man who can accept defeat through the preservation of his principles. Here is a chance for the Illuminating Engineering Society to show their impartiality, by sending a protest to the Manchester Corporation against such an abuse of the principles of street lighting as is demonstrated in Portland Street. Now will Mr. Gaster kindly lead off?

We do not for a minute suppose that our electrical contemporaries will point out to their readers the lessons of the Manchester report as we have set them out here. Our friends have an easy way of maintaining a dead-silence on awkward points; and they are ever declining to deal with difficult questions that are put before them. There was the Cramb episode, in connection with which we thrice invited a friendly test on certain lines and conditions. Silence! There were certain church accounts published in the "Electrical Times" as representing the actual consumptions of gas during specific periods which did not square with the accounts in the books of the gas company, and were obviously payments without reference to periods. The "Electrical Times" was asked, in fairness, to quote the actual accounts as copied from the gas company's ledgers. So far—Silence! There was

the "Electrical Review," who spoke of the "exact opposite" of the Lewes eulogium of gas. Our contemporary was asked to point out categorically and scientifically where Professor Lewes erred. Silence! The same paper recently referred to the "peculiar properties" of gas. An explanation was sought. Silence! The "Review" pleaded for the abolition of gas from railway trains, on the ground that it was under the impression that gas had contributed to the tragic side of railway accidents. The paper was asked why it had not pleaded for the eviction of electric lighting from drapery establishments, on the ground that fires electrically produced had had the same tragic results. Silence! Challenges have been issued on the subject of electrical cooking, boiling, &c. Silence! Some matters appearing in Mr. Borlaise Matthews' book "Electricity for Everybody" do not agree with our knowledge. We asked that gentleman for scientific explanations of what we regard as being banal or inaccurate statement. So far—Silence! These are only a few points that cross the mind where there has been refusal to toe the line. But our contemporaries might face the true lessons of the Manchester reports as pointed out in the previous paragraph, and explicitly and pointedly call the attention of the electricity industry to them.

Talking of electric cooking, an article on the subject, published in the "Daily Mail," has just been read. It is signed "Mary Desbrisay." Mary says a lot; but much of it is in the nature of pure postulation. Her knowledge of the subject is well epitomized by the statement she makes that "the Board of Trade measures electricity by the unit. One thousand candle-power, burning for one hour, consumes one unit of electricity." That is not technically and nicely put. Candle power does not burn at all; and 1000-candle power in one hour requires at least 25 to 30 per cent. more than the unit, according to the most careful photometric and energy-metered tests, with the best metallic filament lamps bought over the counter. But what Mary Desbrisay has to talk about is chiefly cooking; and she tells those old stories about wonderful savings that are to be effected by adopting electricity. She is not, however, going to fall into the pit in which many predecessors have had unlucky spills by fastening themselves to absurd definite figures. She starts off with the airy statement that the electric cooker costs practically the same as any present arrangement of a kitchen range and gas-cooker—that is to say, the electric cooker is the equal of the kitchen range and gas-cooker combined. Mary Desbrisay cannot know much about the electric cooker, nor about its inefficiency, in comparison with other means for doing the work, including all boiling purposes. In one house of which we have knowledge, in which an electric-cooker was installed, how the mistress and the lady of the kitchen rejoiced over the presence of the coal range in the kitchen for doing work that the electric-cooker positively declined to do, other than in its own off-handed, leisurely fashion!

There is on our part daily acquaintance with a house where the ordinary kitchen range is rarely in use, except for the provision of bath water, owing to the existence there of a good gas-cooker and gas means for providing a supply of hot water for kitchen use. What is done in this way, we defy Mary Desbrisay to do with her electric-cooker—in quantity, in time, or at a like cost. What is the good of pretending things that when thoroughly examined are found to be anything but actualities? We go on finding Mary giving 1½ units as the expenditure of current per person per day for cooking. Mr. Holmes, of Marylebone, places the figure per person per day at 1·9 units. Do the 1½ units include everything? Water heating for all kitchen purposes, for meals, and for boiled food? The lady proceeds to mention a small middle-class house in which the entire cost of the day's cooking by electricity is 6d. This economical household starts the morning by boiling rather more than 2 pints of water in four minutes—so Mary says—at a cost of less than one-fifth of a penny. We are prepared to say that both the time and cost are understated, unless this small household has alighted on an electric heating arrangement which we have not had an opportunity of investigating or hearing about. If any of our electrical friends know who Mary Desbrisay is, they might ask her to send us on particulars of this extraordinary electric "boiler or kettle." There is no occasion to enter into the other particulars. But about the total of 6d. per day for cooking. It works out to 3s. 6d. per week, supposing there is never any departure from the daily routine of this *ménage*, and the day's expenditure remains inflexibly at the 6d. per day. The 6d. amounts to £2 5s. 6d. per quarter—a larger account than has had to be met in each of the past two quarters in a house (with five persons) for all the gas lighting, cooking, and water heating, save for the bath, and coke is generally used in the kitchen range for that purpose.

Among specimens of new electrical literature for circulation that have just been sent out is one dealing with "Electric Show Window Lighting: Valuable Hints for Christmas Trade." Has the British Commercial Gas Association a similar leaflet; if so, perhaps there are managements of gas undertakings who would like to hear of it. This one is well illustrated with pictures of brilliantly lighted shop windows—the light and shades in certain cases coming out in such a peculiarly unnatural manner that one feels that the art of the photographer in "touching-up" has been brought into play. There is really nothing of importance to which exception can be taken in the statements accompanying the photographic reproductions. The whole is an appeal to enterprising and progressive shop owners to make their shops attractive by good and scientific illumination. There is no question that a good scheme of illumination is economical; and there is equally no question that a well-lighted shop pays better than one that is miserably lighted. People will go to well-lighted thoroughfares, and they will stop and examine the contents of well-lighted shops. There is agreement on our part on most points with the writer of the leaflet. One thing we do not notice in this "Valuable Hints for Christmas Trade" is a warning that just any sort of electrical fitting-up will not do. The absence of that "hint" is a pity, because fires and even death have been traced to these special electrical decorations at Christmas time. Nor is there mention of the fact that it is inadvisable for tradesmen to put their trust entirely in electric lighting; but that it will be a trade protection, if those who prefer electric lighting, will retain their gas-fittings, as many tradesmen have had their Christmas trade partially ruined by a sudden extinction of the electric light—sometimes when business was at its apex on Christmas Eve. Gas undertakings have secured a good many converts by such happenings on Christmas Eve and at other times.

In a letter to the "Electrical Review," Mr. A. F. Harrison, the Chairman of the Electric Supply Publicity Committee, writes to point out that whereas the British Commercial Gas Association sold over 700,000 pamphlets in its first year, the Electric Supply Publicity Committee have sold over 2½ millions in two-and-a-half years. In other words (Mr. Harrison does not make a point of this), the older organization has only averaged a sale of about a million circulars a year, while the British Commercial Gas Association, starting operations only a year ago without a single pamphlet written or printed, nearly overtook the electrical average in the months that remained after the leaflets were prepared. The Electricity Publicity Committee have not much to crow about in the comparison Mr. Harrison makes.

We must in future speak of Mr. A. H. Seabrook, the Borough Electrical Engineer of Marylebone, with due reserve and in terms of profound respect. In his series of lectures, or talks to young men, at the East London College [to which reference has already been made in the "Memoranda"] he was, it will be remembered, recently advising his hearers always to make a "square deal." In the second lecture, he laid down another rule that he urged should be treated as sacrosanct. It was this, "Abide by the rule which says never abuse or run down your competitor." Will Mr. Seabrook now kindly withdraw those Electrical Department advertisements upon which we recently commented, and which are to be found in a little guide-book treating of the borough of St. Marylebone? There is a point in this particular lecture with which we strongly concur. Mr. Seabrook is a municipal officer, but he is not in agreement with the management of public utilities by municipal bodies. According to the report before us, he advocated management by a public company subject to State control and regulation, which were the legitimate and necessary functions of the State. He objected to the State stepping out of its proper legislative sphere and embarking in commerce and trade. Similar criticisms, he said, applied with greater force to municipal electricity undertakings, which, it was extremely regrettable, were in the majority. Although some were *apparently* successful, they would be even more so if they were owned by a company which could adopt proper relationships with their employees without being open to the charge of vote-catching and wire-pulling. Taking the case where the electricity undertaking was under municipal authority, the situation was, he said, Gilbertian, when, if it failed, money was taken from the rates, to which the local gas company contributed, in order to make good the loss. In no case was it permissible for the two rival undertakings, gas and electricity, to be under one management. This practice was dangerous, as, though it might benefit the shareholders, it would be disadvantageous to the public in the long run. We are not so sure about this in small towns where probably the existence of two independent competing companies might make it impossible for one of the two or both to make a living.

In defiance of order, and of the Secretary of State for the Home Department and his staff, the electric installation at the Home Office caused an outbreak of fire last Wednesday afternoon. The electric lights on the second floor were suddenly extinguished. It was discovered that the main switch had fused, and that a basement cellar was ablaze. A main cable also fused; and the Home Office for a time learnt something as to the pungent fumes that can, and do, arise from this cause. However, the Home Office is prepared for visitations of this kind. It is recognized that a plentiful supply of sand is at times a valuable concomitant of an electric lighting installation; and by the aid of sand the unwelcome cause of alarm was suppressed. Even the Government cannot legislate to prevent electrical vagaries of this sort.

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In setting up apparatus, occasions often arise where rubber tubing is objectionable, and fusion of the tubes inconvenient. In the "Chemical News" recently, Mr. W. R. Forbes, B.Sc., gave the following convenient method of surmounting the difficulty: Take a short piece of glass tube of wider bore than the tubes to be joined, and fill it with wax. Bore a tube through the wax, and slip the piece over the tubes to be joined. To mould the tubes, place an iron rod in the middle of the short glass piece, and fill up with wax. If the iron rod is long, its end may be warmed; and, the heat travelling by conduction, it may easily be withdrawn, leaving the mould complete. A supply of these tubes can be quickly made and kept ready for use.

# WATER LEGISLATION FOR 1912.

[Second Article.]

In the last number of the "Journal," the principal features were noticed of the Acts of the present session conferring additional powers on companies in respect of the supply of water. We now deal with the corresponding provisions in the Acts of local authorities.

The Bedwellty Urban District Council are empowered to purchase certain gas and water undertakings, and supply gas and water in their district. The gas portion of the Act was fully noticed in the "Journal" for the 22nd ult. (p. 276). The water undertakings included in the Bill were the New Tredegar Company, with whom an agreement had been entered into, and the Rhymney and Aber Valleys Gas and Water Company, the portion of whose undertaking lying in part of Bedwellty was required. The agreement with the first-named Company is confirmed; but the proposal regarding the latter was not carred into effect. The water limits of the Council are extended and defined; and the rates at which water is to be supplied for domestic purposes are specified. They are to be based upon the rateable value of the premises, and they range from 3d. and 4d. per week to from 10 down to 6 per cent. per annum, with extras. The Council are authorized to purchase water in bulk, and to enter into contracts for supplying it beyond their water limits; and they may sell by measure—the price in this case to be not more than 1s. 6d. per 1000 gallons, compared with 2s. in the Bill. Power is given to supply fittings. The Council may borrow such an amount as may be necessary to purchase the undertakings specified in the Act, and (with the consent of the Local Government Board) any money needed for the extension and improvement of the works acquired and for providing working capital. The money borrowed for water-works purposes is to be repaid within forty-five years from the date of borrowing. The Act empowers the Gelligaer Council to purchase the mains, pipes, and apparatus within their district, if they promote a Bill for the purpose in either of the next two sessions. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Belfast City and District Water Commissioners have obtained an extension of the time limited by their Act of 1893 for the construction of the storage reservoir in the valley of the Kilkeel River (as altered and varied by the Act of 1903), and for the completion of other works authorized by the first-named Act, to the 27th of July, 1925; also an extension of time in regard to the reservoir in the Annalong Valley and other works sanctioned by the Act of 1897, on conditions laid down in the Act. The powers for the compulsory purchase of lands authorized by the Act of 1899 are revived; and authority is given to acquire additional lands (which are fully specified) for water-works purposes. Permission is granted to borrow such further sums of money, not exceeding £500,000, as shall be requisite for the general purposes of the undertaking. The Act contains a section which is of so unusual a character as to justify its reproduction *in extenso*:

> The Commissioners may, out of the revenues of their undertaking, pay reasonable subscriptions, whether annually or otherwise, to the funds of any society having for its object the scientific study of water supply, and any association of water-supply authorities or their officers formed for the purpose of consultation as to their common interests and the discussion of matters relating to water supply, and any reasonable expenses of the attendance of any of the Commissioners or their officers, not exceeding in any case four, who may be appointed by the Commissioners to attend at conferences or meetings of the said associations held within the United Kingdom.

As the clause stood in the Bill, there was no limit to the number of delegates attending the conferences referred to; and authority was sought for the purchase of reports of the proceedings thereat. The limit of the domestic water-rate mentioned in the Act of 1884 is altered from 1s. 8d. to 2s. 6d. All hotels, clubs, barracks, or institutions of a public nature, supplied with water are to be assessed to the public, and not to the domestic, rate; and the Belfast Poor Law Guardians and public bodies are not to be exempted from the payment of water-rates in respect of hospitals and school buildings belonging to them. [*Parliamentary Agents: Messrs. Martin and Co.*]

The Church Stretton Urban District Council have obtained authority to purchase the undertaking of the Church Stretton Water Company, and supply water within the parishes of Little Stretton and All Stretton, in the county of Salop. The Council are to serve upon the Company, within six months after the passing of the Act, notice of their intention to purchase. The price is to be settled, in default of agreement, by arbitration; and the Council are to pay the costs of obtaining the Company's Act of 1899, the taxed costs and expenses incurred by the Company in obtaining clauses and amendments for their protection in the Bill for the present Act, those incidental to any arbitration proceedings and the winding-up of the Company, and the Company's expenditure on capital account in carrying on the undertaking pending the transfer. The rates at which water is to be supplied for domestic purposes are those specified in section 36 of the Act of 1899, except the first proviso thereof. The Council are authorized to borrow the necessary money for the purchase of the undertaking and payment of the costs of the Act. The amount raised for the former purpose is to be repaid within forty-five years from the date of borrowing; the rest within five years from the passing of the Act. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Derwent Valley Water Board have obtained an extension of the time limited by their Act of 1909 for the compulsory purchase of lands, and authority to make provisions in regard to gauges for compensation water. The lands in question are situated in certain parishes in the county of Derby; and the period for their purchase is extended to three years from Aug. 16, 1912; being seven years less than was specified in the Bill. Section 3 enacts that the compensation water to be discharged by the Board out of the Derwent reservoir into the River Derwent, under the provisions of section 52 of the Act of 1899, is to be measured at the Locker Brook gauge, or at some point above it, instead of within the limits prescribed by section 54 of the above-named Act, the provisions of which in reference to the apparatus and the method of measuring the water are to apply and have effect accordingly. [*Parliamentary Agents: Messrs. Dyson and Co.*]

One section in the General Powers Act of the Dover Corporation relates to water supply. It enables the Corporation to enter into agreements with the East Kent District Water Company with reference to the reduction of the rates charged for water in the portion of the borough included within the statutory limits of the Company, in order that they may correspond with those now charged by the Corporation in the rest of the borough. It is specified that the Company are not to be paid any higher rate than that levied in other parts of their statutory limits of supply. Any outlay incurred by the Corporation under this section is to form part of the expenses of the water undertaking of the Corporation. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Egremont Urban District Council are authorized to construct and maintain water-works, and supply water within their district. The works consist of an intercepting dam or intake weir and gauge in the parish of Ennerdale and Kinniside, to be situated upon the Wormgill Beck, an intake or settling-tank in the same parish, a service reservoir in the parish of Haile, and two aqueducts or pipe-lines. Five years are allowed for the completion of the works, instead of the seven applied for. The Wormgill Beck and Bleaberry Gill, with their tributary waters, are to be the sources of supply. The charges for water are based upon the rateable value of the premises; being 8s. 8d. where it does not exceed £5 per annum, 11s. between this and £7, 7½ per cent. up to £20, and 7 per cent. beyond this. For supplies by meter, the charge is not to exceed 1s. per 1000 gallons. Provision is made for a supply of water in bulk. The Council are empowered to borrow £27,500 for the purchase of lands and easements, and the construction of the works specified, £1000 for relaying and extending mains, and the sum required for paying the costs and expenses of the Act—the two amounts named to be repaid within thirty years from the date of borrowing, and the costs within five years from the passing of the Act. [*Parliamentary Agents: Messrs. Hargreaves and Crowthers.*]

The Fylde Water Board are empowered to construct additional works, and make better provision in regard to their undertaking. The works are of an extensive character; comprising three impounding reservoirs, two service reservoirs, nine aqueducts or pipe-lines, and four road diversions. Four impounding reservoirs and ten pipe-lines were specified in the Bill. The Board are granted twenty years for the completion of the works. Provision is made for taking water, subject to certain restrictions, from the River Hodder and the Bottoms Beck. The Board are authorized to borrow £1,036,985 for the purchase of land and the construction of reservoirs, making road diversions, &c.; £386,379 for the aqueducts; and the necessary amount for paying the costs and expenses of obtaining the Act. Sixty years are allowed for repaying the first amount, forty-five for the second, and five for the last. The amounts granted are less than those applied for; but, as already mentioned, the works included in the Bill have been somewhat curtailed. The Act necessarily contains a large number of protective provisions; and it specifies that after the Board commence to supply water from any of the works authorized, they are to sell to the Bowland Rural District Council such daily quantity of water as they may require at the price of 6d. per 1000 gallons. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

## Southern Association Commercial Section.

The annual general meeting of the Commercial Section of the Southern District Association of Gas Engineers and Managers was held on the 30th ult., at the Bedford Hotel, Southampton Row—the Chairman (Mr. W. E. Price) presiding over a good attendance. The officers elected for the ensuing year were: Chairman, Mr. H. C. Head; Committee, Messrs. S. Carpenter, P. P. Channon, F. W. Cross, S. Y. Shoubridge, L. Trewby, H. W. Woodall, and W. E. Price (*ex-officio*); Hon. Auditor, Mr. A. F. Browne; Hon. Secretary and Treasurer, Mr. R. Seymour Tobey. A unanimous vote of thanks was accorded to all the officers for the efficient manner in which they had carried out the duties in their various official capacities. A record was also placed on the minutes of appreciation by the members of the excellent services rendered to the section by Mr. Price as Chairman during and since its formation, "as he had been untiring in his efforts to bring the section to its present flourishing position." The annual report was approved and adopted, and will be presented to the Southern District Association at the meeting on Thursday.

Mr. N. E. B. Garey has resigned his seat on the Board of the Continental Union Gas Company, Limited, and Mr. E. A. Goulding, M.P., has been elected to the vacant seat.

# STUDY OF THE "SHADOWGRAPH" TEST FOR GAS-FIRES.

By W. J. A. Butterfield, M.A., F.I.C., Assoc.Inst.C.E.

The description which was given in the "Journal of Gas Lighting" for July 30 last, of the "Shadowgraph" method of testing the ventilation of gas-fires, as devised by the technical staff of the Davis Gas-Stove Company, Limited, greatly interested the present writer. He had been in the habit of checking the sufficiency of the ventilation afforded by the elbow and flue of a gas-fire by determinations of the proportion of carbonic acid in the air immediately above and in front of the canopy of the fire. Such a method of ascertaining whether any portion of the products of the gas is escaping in front of the canopy is fairly satisfactory, but is only readily carried out by analysts who are constantly making similar determinations of the carbonic acid in air. The ideas suggested by the description of the Shadowgraph method of testing led the writer to the conclusion that it presented an alternative method to that of determinations of carbonic acid, which had the advantages of great simplicity and of being readily applied by observers who were untrained in methods of chemical analysis.

The writer therefore welcomed a suggestion which the Davis Gas-Stove Company, Limited, made to him a few weeks ago, that he should investigate, in any way which he desired, the working of the Shadowgraph test. Since it involves points of considerable novelty in connection with the action of flues, an account of the investigations which he made, and the conclusions to which they led, may be acceptable to some of the large circle of technical men interested in the construction and efficiency of gas-fires.

The consideration of the matter may conveniently be made under two headings—viz.: (1) A discussion of the principles involved in the application of the Shadowgraph test, and (2) an account of experimental results obtained by the writer in the use of it.

## THE PRINCIPLE OF THE SHADOWGRAPH TEST.

### Description of the Test.

The Shadowgraph test may be said briefly to depend on the condensation on a cooled plate of some of the water vapour which the products of combustion of town gas contain. The proportion of water vapour in the products of combustion of town gas is always greater than in the air of a living room, and hence a plate cooled to a certain temperature will condense water vapour from products of combustion but not from the air of a room. The right temperature for the plate, in order that this effect may be obtained, must obviously lie between the dew-point of the air and the dew-point of the products. How great is the range of temperature thus available for the observations will be discussed shortly. For the rest, in the Shadowgraph test, as now carried out, the plate is of glass; and one edge is cut to fit closely against the canopy of the fire when the plate is held in a vertical plane at right angles to the fire-front. Any water which condenses on the sides of the plate renders it more or less opaque. Hence when the profile of the plate is projected by a lantern on a screen the condensed water causes a marked shadow on the image of the plate on the screen.

### Gases which Escape from the Canopy of a Gas-Fire.

If the whole of the products of combustion from a gas-fire are not removed through the flue opening, the portion not so removed will escape in front—for the most part issuing from under the bottom edge of the canopy and thence passing upwards into the room. If this portion of the products is more than a quite negligible proportion of the total products of combustion, it will have substantially the same composition as the portion which is removed through the flue opening, as the following considerations will show. The stream of hot products of combustion from the fire, more or less diluted with air, rises to the chamber within the canopy, and either passes thence wholly through the flue opening or is baffled and divided into two streams, one of which passes through the flue opening while the other passes out in front from beneath the lower edge of the canopy. In the latter case, the baffling will further the admixture of the products of combustion proper with the surplus air which they carry upwards into the canopy chamber; and the mixture which issues from the canopy will be substantially the same in composition whether it comes through the flue opening or from under the front edge of the canopy. It is evident that if there is a stream of products outwards at the edge of the canopy, any stream of air which would otherwise be drawn in a reverse direction under this edge towards the flue will be forced down by the outstreaming products to a lower stratum, and thus cause very little or no local dilution of those products. Incoming air can only cause general dilution of the products in the chamber of the canopy where baffling and mixing occur. Hence it appears clear that if any products of combustion are escaping from under the edge of the canopy they will quite locally round that edge have substantially the same composition as the products or flue gases which pass through the flue opening.

### Composition of the Flue Gas from a Gas-Fire.

If products therefore are escaping from under the edge of the canopy of a gas-fire, they will, before they have risen into, and become diluted by, the air of the room, contain approximately the same proportions of water vapour and carbonic acid as the flue gas from the fire contains as it issues through the flue opening to the flue-pipe or chimney. In order, therefore, to realize what is the composition of the escaping products which it is the purpose of the Shadowgraph test to detect, it is necessary to know what is the composition of the flue gas from a gas-fire. Naturally, the composition of this flue gas varies with the extent to which the products of combustion proper are diluted with surplus air. This dilution depends on the design of the fire, and (if the fire is fixed on a hearth) on the flue or chimney draught. But whatever the degree of dilution with air, and whether it occurs in the burners, in the canopy, or in the flue-pipe, the constituents of the flue gas at any point will bear a relation one to the other such that if the proportion of any one constituent is known, the proportion of any other constituent may be inferred with precision. This inference will be affected only by: (1) A variation in the composition of the air with which the fire is supplied—*i.e.*, of the air of the room; and (2) the gas consumed requiring more or less oxygen for its complete combustion and producing from it more or less carbonic acid and water vapour than a normal quality of town gas.

In regard to the first point, the composition of the air of a living room heated to a comfortable temperature by a well-ventilating gas-fire will not vary very greatly, and may be taken for the present purpose at that of pure outside air containing 70 per cent. of the amount of water vapour which would saturate it at 64° Fahr. The latter is a comfortable living room temperature; 70 per cent. is a reasonable degree of humidity; and as regards purity of the air, the calculations will not be seriously affected if the air is in fact slightly vitiated—*i.e.*, its content of carbonic acid increased and of oxygen diminished—by the breathing of the occupants, &c. The air supplied to the fire may therefore be taken as containing, in volumes per cent.: Nitrogen, argon, &c., 77·93; oxygen, 20·64; water vapour, 1·40; carbonic acid, 0·03. The dew point of this air will be 54° Fahr.

In regard to the second point, the ordinary variations in the composition of town gas do not cause very wide differences in the volume of oxygen consumed and the volumes of carbonic acid and water vapour produced from a given volume of gas. One cubic foot either of mixed gas or of coal gas produced at high heats of carbonization will require on the average one cubic foot of oxygen for its complete combustion, and will produce about half a cubic foot of carbonic acid and one and one-fifth of a cubic foot of water vapour—measured at the same temperature. The departure from these figures will not be great with any ordinary town gas supply, and the composition of flue gas calculated from them will correspond very closely with the relative proportions actually obtaining in the flue gas from a gas-fire connected to any English town gas supply.

### Relative Proportions of the Components of Flue Gas.

Bearing these facts in mind, the writer has calculated Table I., which shows how the composition of the flue gas resulting from town gas varies as the amount of air supplied to the fire is varied. At one end of the table is shown the composition of pure air unmixed with products of combustion, and at the other end the composition of the products of combustion of town gas undiluted with any surplus air. Between these two extremes must lie the composition of all flue or chimney gases resulting from the complete combustion of town gas; and this composition has been worked out for twenty cases representing dilution of the products of combustion proper by successive increments of one per cent. of oxygen in the flue gas. The corresponding composition for any intermediate proportions of oxygen may be deduced from the diagram fig. 1 (p. 496) or by interpolation from the table.

The percentage of any one component may also be deduced from that of another by the following formulæ, in which

X = the percentage of oxygen in the flue gas
N = " " nitrogen " "
A = " " water vapour " "
C = " " carbonic acid " "

$$X = 2{\cdot}098\ (N - 68{\cdot}09)$$
$$\text{or } X = 0{\cdot}9613\ (22{\cdot}87 - A)$$
$$\text{or } X = 2{\cdot}29\ (9{\cdot}04 - C)$$

$$N = 68{\cdot}09 + 0{\cdot}4767\ X$$
$$\text{or } N = 77{\cdot}93 - 0{\cdot}4583\ (A - 1{\cdot}40)$$
$$\text{or } N = 77{\cdot}93 - 1{\cdot}0921\ (C - 0{\cdot}03)$$

$$A = 22{\cdot}87 - 1{\cdot}0402\ X$$
$$\text{or } A = 22{\cdot}87 - 2{\cdot}182\ (N - 68{\cdot}09)$$
$$\text{or } A = 1{\cdot}40 + 2{\cdot}383\ (C - 0{\cdot}03)$$

$$C = 9{\cdot}04 - 0{\cdot}43653\ X$$
$$\text{or } C = 9{\cdot}04 - 0{\cdot}91565\ (N - 68{\cdot}09)$$
$$\text{or } C = 0{\cdot}03 + 0{\cdot}41975\ (A - 1{\cdot}40)$$

The upper half of the table and the diagram (fig. 1) refer to the composition of the flue gas before any water vapour has been condensed or removed from it. The composition stated will be correct only so long as the flue gas is maintained above its dew point, which is given in the middle line of the table. In ordinary

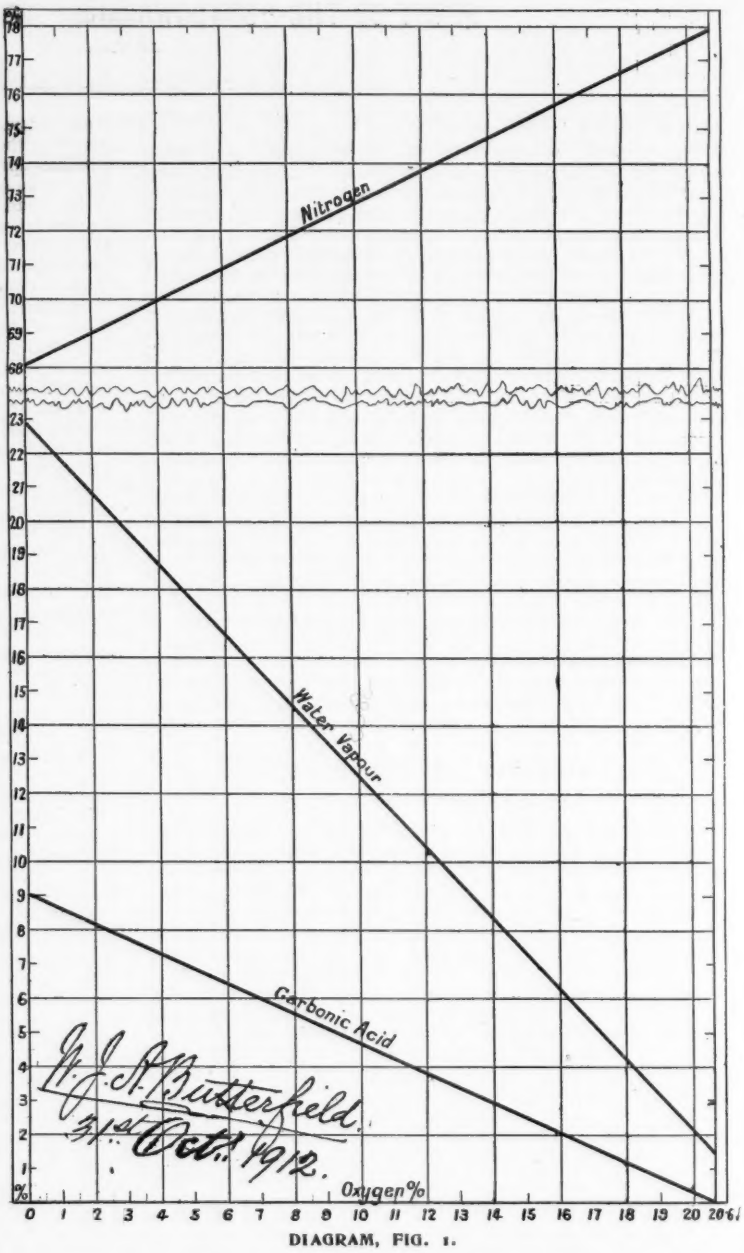
analyses of flue gas and other gases, the water vapour is not determined, and the results for the other constituents are returned in percentages by volume of the gas free from water vapour. The corresponding figures on this basis are shown in the lower half of Table I. The constituent of flue gas which is ordinarily determined with the greatest ease is carbonic acid. Assuming that by ordinary methods of gas analysis the percentage of carbonic acid in the flue gas from a gas-fire has been found to correspond with one of the values given for carbonic acid in the lower half of Table I., there will be found above that value in the same vertical column of the table the composition of the flue gas before condensation or removal of its water vapour, and its dew point. Conversely, if the dew point of the flue gas from a gas-fire is ascertained at any point, the composition of the flue gas at that point may be inferred with a sufficient degree of accuracy for all practical purposes in connection with the ventilation and investigation of gas-fires. It is, of course, essential in the latter case that the dew point should be ascertained before the flue gas has been cooled to any appreciable extent—*i.e.*, before any water vapour is removed from it by condensation.

The diagram fig. 2 gives a curve from which the dew point of the moist flue gas from a gas-fire may be read, corresponding with any percentage of carbonic acid or oxygen found by analysis in the flue gas (regarded as free from water vapour).

### Dew Point of the Flue Gas.

The writer believes the accompanying table, diagrams, and formulæ may be of general utility in gas-fire investigations, and he has therefore made them rather more comprehensive than is requisite for the immediate purpose of this study of the Shadowgraph test. For this purpose, the all-important matter is the range of the dew point of the flue gas, according to the extent to which the products of combustion proper are diluted with surplus air. As a fact, the diluted products issuing from the flue-opening of a modern gas-fire (with or without an elbow and a reasonable length of flue pipe attached) will almost invariably contain more than 12 per cent. and less than 19 per cent. of oxygen. Generally, they will fall within the more limited range of 13 to 18 per cent. of oxygen. Taking the wider range named first, the dew point of the flue gas will always be somewhere between 77° and 116·5° Fahr. Since the dew point of the air of the room will be, as already mentioned, about 54° Fahr., it is evident that there is in every case ample difference between the dew point of the air and the dew point of the flue gas for advantage to be taken of it for the distinguishing of air from flue gas.

All that is necessary for distinguishing between air and the flue gas from a gas-fire is therefore a means of ascertaining whether the dew point is somewhere in the neighbourhood of or below (say) 55° Fahr., or whether it is above (say) 75° Fahr. For instance, the dew point may be ascertained from readings of the hygrometer (or wet and dry bulb thermometers) exposed in the air or flue gas. The dew point, however, need not be exactly ascertained if the purpose is merely to distinguish between air and flue gas. It is sufficient in all ordinary cases to have a smooth surface of badly conducting material at a temperature lying between about 55° and 75° Fahr. In the air of the room no condensation of water on the surface will occur; but in the flue gas there will be copious condensation until the surface attains a temperature above that of the dew point of the flue gas—*i.e.*, 75° Fahr. or over. The Shadowgraph test appears to the writer to afford a convenient means of obtaining and observing the condensation on a cool surface which naturally occurs from flue gas but does not occur from air in the ordinary conditions of a living room.




DIAGRAM, FIG. 1.

### Applicability of the Shadowgraph Test.

It has already been demonstrated that any gases which escape from beneath the front of the canopy of a gas-fire will at their point of escape have substantially the same composition as the gases passing through the flue outlet at the same time. Dilution by air will occur as the escaping gases pass up on the outside of the canopy into the air of the room; but at the point of escape—*i.e.*, close round the lower edge of the canopy—they will be flue gas no more diluted than the flue gas passing through the flue outlet. Hence a cool plate on which condensation of water from flue gas can be obtained and observed will serve perfectly for the detection of escaping products—*i.e.*, flue gas—from the front of the canopy of a gas-fire. It is on this account that the Shadowgraph is a reliable test by which any escaping products may be detected. Since the dew point is lowered by dilution with air, and it is only close round the lower edge of the canopy that the flue gas is undiluted, it is evident that the detector plate should come close to the rim of the canopy. Since the heat from the fire at this point is considerable, the plate must, moreover, be of such material and substance that its surface will remain cool for a sufficient time for the condensation on it to take place and the shadow caused thereby to be observed and, if necessary, photographed. The thick glass plate adopted in the Shadowgraph test fulfils this condition. Further, the plate must not be so cold that its temperature will be below the dew point of the air of the room, and that therefore condensation will take place on it from the air. The test is best applied in a room with reasonably cool and unvitiated air; but there is, in fact, a sufficient margin between the dew point of even hot and vitiated—*i.e.*, highly humidified—air and the dew point of flue gas for the test to be applicable in all likely conditions.

### Sensitiveness of the Shadowgraph Test.

It might at first thought seem likely that a small escape of products of combustion in front of the canopy of a gas-fire would not be detected by the Shadowgraph test, because the condensation on the plate would in that case be so slight. But bearing in mind what has already been said in regard to the identity of the flue gas and the escaping products at the point of escape, it is evident that if there is any escape of products and the detector plate extends to the point of escape it will detect them infallibly, whether the volume escaping is large or small. If the flow or volume of escaping products is large, the zone round the front edge of the canopy through which they pass before dilution will be wider than if the flow or volume of escaping products is small. That is to say, the obscured area on the detector plate will extend farther outwards from the edge of the canopy the greater is the escape of products therefrom; but there will be little or no difference in the density of the deposit or shadow in the portion immediately contiguous to the edge of the canopy. Upwards from the edge of the canopy the density will fade away gradually as the products mix with the air of the room and the dew point of the mixture falls.

TABLE I.—*Showing the Variation in Composition of the Flue Gas Resulting from the Combustion of Town Gas, According to the Extent to which the Products of Combustion are Diluted with Surplus Air.*

One volume of town gas is assumed to require one volume of oxygen for its combustion, and to produce 0·5 volume of carbonic acid, and 1·2 volumes of water vapour. The air is assumed to be 70 per cent. saturated at 64° Fahr.

COMPOSITION, IN PERCENTAGES BY VOLUME, OF THE FLUE GAS, INCLUSIVE OF WATER VAPOUR.

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oxygen . . . . . per cent. | 0·00 | 1·00 | 2·00 | 3·00 | 4·00 | 5·00 | 6·00 | 7·00 | 8·00 | 9·00 | 10·00 | 11·00 | 12·00 | 13·00 | 14·00 | 15·00 | 16·00 | 17·00 | 18·00 | 19·00 | 20·00 | 20·64 |
| Carbonic acid . . . . . ,, | 9·04 | 8·60 | 8·17 | 7·73 | 7·29 | 6·86 | 6·42 | 5·98 | 5·55 | 5·11 | 4·67 | 4·24 | 3·80 | 3·36 | 2·93 | 2·49 | 2 05 | 1·62 | 1·18 | 0·75 | 0·31 | 0·03 |
| Nitrogen . . . . . ,, | 68·09 | 68·57 | 69·04 | 69·52 | 70·00 | 70·47 | 70·95 | 71·43 | 71·90 | 72·38 | 72·86 | 73·33 | 73·81 | 74·29 | 74·76 | 75·24 | 75·72 | 76·19 | 76 67 | 77·15 | 77·62 | 77·93 |
| Total, exclusive of water vapour ,, | 77·13 | 78·17 | 79·21 | 80·25 | 81·29 | 82·33 | 83·37 | 84 41 | 85·45 | 86·49 | 87·53 | 88·57 | 89·61 | 90·65 | 91·69 | 92·73 | 93·77 | 94·81 | 95·85 | 96·90 | 97·93 | 98·60 |
| Water vapour . . . . . ,, | 22·87 | 21·83 | 20·79 | 19·75 | 18·71 | 17·67 | 16·63 | 15 59 | 14·55 | 13·51 | 12·47 | 11·43 | 10·39 | 9·35 | 8·31 | 7·27 | 6·23 | 5·19 | 4·15 | 3·10 | 2·07 | 1·40 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Dew point . . . . . Degrees Fahr. | 146·0 | 144·1 | 142·2 | 140·2 | 138·1 | 136 0 | 133·7 | 131·2 | 128·6 | 125·9 | 123 0 | 119·9 | 116·5 | 112·8 | 108 7 | 104·2 | 99·0 | 93·1 | 86·0 | 77·0 | 65·0 | 54·0 |

CORRESPONDING COMPOSITION, IN PERCENTAGES BY VOLUME, OF THE FLUE GAS, EXCLUSIVE OF WATER-VAPOUR.

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oxygen . . . . . per cent. | 0 00 | 1·28 | 2·53 | 3·74 | 4 92 | 6·07 | 7·20 | 8 29 | 9·36 | 10·40 | 11·42 | 12·42 | 13·39 | 14·34 | 15·27 | 16·18 | 17·06 | 17·93 | 18·78 | 19·61 | 20·42 | 20·93 |
| Carbonic Acid . . . . . ,, | 11·72 | 11·00 | 10·31 | 9·63 | 8·97 | 8·33 | 7·70 | 7·09 | 6·50 | 5·91 | 5·34 | 4·79 | 4·24 | 3·71 | 3·19 | 2·68 | 2·19 | 1·71 | 1·23 | 0·77 | 0·32 | 0·03 |
| Nitrogen . . . . . ,, | 88·28 | 87·72 | 87·16 | 86·63 | 86·11 | 85·60 | 85·10 | 84·62 | 84·14 | 83·69 | 83·24 | 82·79 | 82·37 | 81·95 | 81 54 | 81·14 | 80·75 | 80·36 | 79·99 | 79·62 | 79·26 | 79·04 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |

TABLE II.—*The Shadowgraph Test Applied to Fires "A" and "B."*

| Fire. | Length of Flue Pipe. | Proportion of Carbonic Acid in Air (exclusive of Water Vapour) about 8 inches above Edge of Canopy, Percentage by Volume. | Humidity, Percentage of Water Vapour. | | Dew-Point, Degs. Fahr. | | Shadowgraph Indication. |
|---|---|---|---|---|---|---|---|
| | | | About 8 ins. above Canopy. | Air of Room. | About 8 ins. above Canopy. | Air of Room. | |
| "B" | No elbow or flue-pipe | 0·416 | 2·48 | 1·88 | 70·1 | 62·1 | Quite distinct and copious. |
| ,, | 12 inches . . . . | 0·146 | 2 04 | 1·84 | 64·4 | 61·5 | Distinct, fairly copious. |
| ,, | ,, ,, . . . . | 0·141 | 2·05 | 1·76 | 64·6 | 60·2 | Distinct, fairly copious. |
| ,, | 24 ,, . . . . | 0·077 | 1·93 | 1·80 | 62·9 | 60·9 | Distinct, less copious. |
| ,, | 36 ,, . . . . | 0·073 | 1·89 | 1·81 | 62·3 | 61·1 | Distinct, but of small extent. |
| "A" | No elbow or flue-pipe | 0·067 | 1·83 | 1·82 | 61·4 | 61·3 | *Nil.* |

TABLE III.—*Shadowgraph Test Applied to Fires "A," "B," and "C," all without Elbow and Flue-Pipe.*

| Fire. | Composition of Air about 2 inches above edge of Canopy. Percentage by Volume (excluding Water Vapour). | | Humidity, Percentage of Water Vapour. | | Dew-Point, Degs. Fahr. | | Shadowgraph Indication. |
|---|---|---|---|---|---|---|---|
| | Carbonic Acid. | Oxygen. | About 8 inches above Canopy. | Air of Room. | About 8 inches above Canopy. | Air of Room. | |
| "C" . . . . | 0·433 | 20·31 | 1·76 | 1·23 | 60·3 | 50·6 | Distinct, copious. |
| "B" . . . . | 0·694 | 19·71 | .. | 1·29 | .. | 51·8 | Very distinct and very copious. |
| "A" . . . . | 0·055 | .. | 1·31 | 1·34 | 52·3 | 52·8 | *Nil.* |

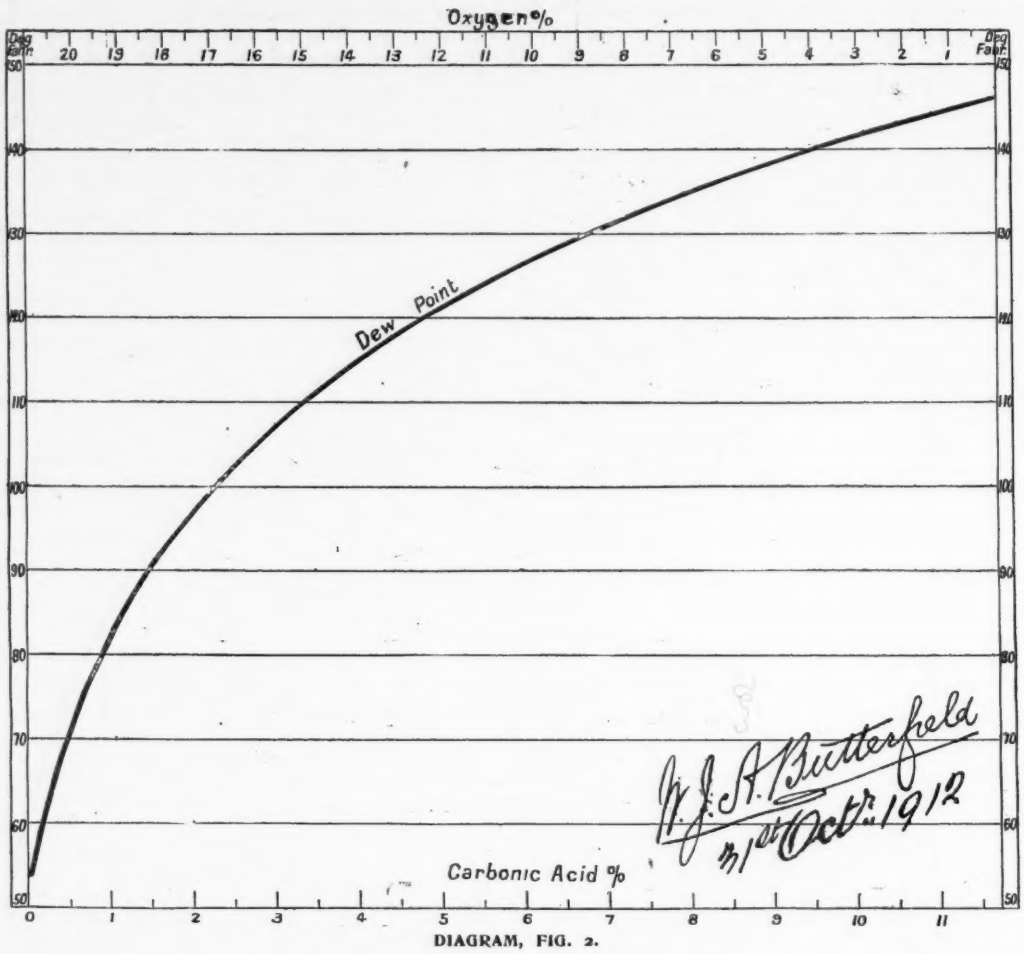
A sample of air taken in the room while fire "C" was under observation contained 0·066 per cent. of carbonic acid.
A sample of products taken at the flue outlet of fire "A" contained 3·836 per cent. of carbonic acid and 14 per cent. of oxygen.

The density of the deposit or shadow will also be greater the less surplus air the flue gas contains, because the proportion of water vapour is greater, and the dew point higher, the less diluted is the flue gas (*vide* Table I. and figs. 1 and 2).

It thus appears from theoretical considerations that the Shadowgraph test affords a reliable means of detecting the presence of products of combustion from a gas-fire. If applied with reasonable care, it should never fail to detect even a small escape of products of combustion from the front of the canopy of a gas-fire, and it should never indicate escape of products when there is none. It has the great advantage over the other methods of testing of which the writer has knowledge that it avoids difficulties of sampling. These difficulties are very great in such cases, owing to the stratification of the heated air currents. It has already been demonstrated that it is only close to the front edge of the canopy that the escaping products will be found in an undiluted state; and if the escape is small, a sample of air taken an inch or even half-an-inch in front of the edge may be quite free from the products which are in fact escaping. Erroneous conclusions as to the sufficiency of the flue-draught or ventilation of a gas-fire may thus readily be drawn, owing to the sample of air for testing not having been taken at quite the right spot. The plate of the Shadowgraph test, on the other hand, lies in a vertical plane which intersects all the zones of air strata into which products escaping from the front of the canopy might pass, and thus does not fail to furnish evidence of any escape there may be of such products. On this account the Shadowgraph test appears to the writer to be inherently more trustworthy than other modes of testing for the escape of products of combustion in front of gas-fires.

## RESULTS OBTAINED WITH THE SHADOWGRAPH TEST.

The writer has made investigations of the Shadowgraph method of testing, with a view to ascertaining whether, in actual use, its indications are trustworthy. These investigations were made in rooms at Luton belonging to the Davis Gas-Stove Company, Limited, and the Shadowgraph test was applied, as and when desired by the writer, by a member of the Company's technical staff. All the control tests and observations were, however, made by the writer and his assistant, Mr. F. L. Bassett, B.Sc., A.I.C. The observations were made on gas-fires standing on the floor of a room away from wall or chimney. In most cases no elbow or flue pipe was attached to the flue opening at the back of the fire; but in the case of one fire, which in these conditions discharged a large proportion of the products of combustion from the canopy in front of the fire, an elbow and flue pipe were afterwards attached to the flue opening—the length of the flue pipe being increased by stages until all the products of combustion were carried away through the flue opening. Three different fires were used. They were all of substantially the same size and width of fire front, and the gas consumption per hour was practically the


Oxygen %
Deg Fahr.
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Dew Point
Carbonic Acid %
0 1 2 3 4 5 6 7 8 9 10 11
W. J. A. Butterfield
31st Oct. 1912

DIAGRAM, FIG. 2.

same in all the tests. The writer believes that they may fairly be taken as representative productions of three well-known firms of gas-fire manufacturers; but as he is now dealing only with methods of testing for the escape of products of combustion, it is quite unnecessary to identify them by name. He will refer to them in the sequel as fires "A," "B," and "C," and only say, in fairness to the Davis Gas-Stove Company, that fire "A," which in no conditions was found by him to discharge any products of combustion in front of the fire, was the "No. 1 Apollo" made by the firm.

### Description of the Control Tests Applied.

Since the Shadowgraph method of testing depends on the absolute humidity of the products of combustion as compared with the absolute humidity of the air of the room, it seemed to the writer that its indications would be best checked by determinations of the humidity of the air and/or escaping products. These determinations were made by readings of a modern hygrometer of the wet and dry bulb thermometer type. From these readings the percentage of water vapour in, and the dew point of, the air or escaping products were deduced by Sprung's formula, and the tables based thereon issued by the Royal Prussian Meteorological Institute [the older tables of Glaisher give practically the same results at all ordinary temperatures].

Determinations of carbonic acid in air being, however, recognized as generally affording the most satisfactory and trustworthy criteria of vitiation of air by products of combustion, control tests were also made thereby. Samples were taken at suitable points above, and slightly in front of, the canopy, and the proportion of carbonic acid in them was determined by Haldane's apparatus. In some cases the proportion of oxygen in the samples was also determined.

The point in front or above the fire, at which the control tests should be applied was the subject of much deliberation. It was obviously impracticable to apply even a well-screened ventilating hygrometer in close contiguity with the hot lower edge of the canopy of a lighted gas-fire. It seemed, however, clear that any products escaping from under the edge of the canopy would rise upwards and would be found, more or less diluted with the air of the room, in a vertical zone extending upwards from the outer edge of the canopy. For comparative purposes, it was desirable that the hygrometer readings should be made in the same spot; and ultimately in most of the observations the hygrometer was suspended so that the bulbs of the thermometers were about 8 inches above the front edge of the canopy and very slightly in front of it. Most of the samples of air for analysis were also taken from the same spot; but a few duplicate samples were taken as close as might be to the edge of the canopy. A comparison of the results of analysis of the latter samples and the samples taken 8 inches above the edge of the canopy gave some indication of the extent to which escaping flue gas had become diluted by air by the time it had reached the latter point.

### Details of Observations.

The set of control observations which appears most instructive was made with fires "A" and "B." Fire "B," when used without elbow or flue pipe, expelled a large proportion of its products of combustion in front of the fire. An elbow and lengths of flue pipe were then added to it until the escape of products in front of the fire had been reduced, as indicated by the detailed results given in Table II.

The results in this table show that the Shadowgraph indications are throughout perfectly consistent with the determinations of water vapour and carbonic acid in the air above the canopy. They are especially interesting, because they were obtained in conditions as unfavourable as could well be to the use of the Shadowgraph test. By the writer's desire, ventilation of the room was checked until the air was hot and highly humidified or vitiated by the products of combustion of gas. The dew point of the air of the room was thus made abnormally high; and on this account some difficulty was experienced first of all by the Shadowgraph operator (who was not accustomed to using the test in such abnormal conditions) in providing detector plates at a temperature above the high dew point of the air. Nevertheless, the indications of the test tallied perfectly with the analytical results. The dew point, percentages of water vapour, and of carbonic acid found at the point 8 inches above the canopy do not, of course, apply to the products at their point of escape round the rim of the canopy, but to these products more or less diluted with air. A part of the detector plate of the Shadowgraph test, however, extended into the zone of undiluted products close to the rim of the canopy, where the dew point would be much higher than at the spot 8 inches above it (except when no products were escaping). Some idea of the difference may be obtained from the fact that a sample of air taken fairly close to the front edge of the canopy of fire "B," with 36 inches of flue pipe attached, contained 0·165 per cent. of carbonic acid, as compared with 0·073 per cent. in the sample taken at the same time 8 inches above the canopy. The former figure, in the conditions prevailing, would tally with a dew point locally of about 66° Fahr., or about 5° above the dew point of the air. It is, therefore, quite practicable to get reliable indications with the Shadowgraph test with only this small difference between the dew point of the flue gas and the dew point of the air of the room.

The foregoing results indicate that the Shadowgraph test can be applied successfully even in conditions fundamentally very un-

favourable to its employment. The results of a few observations made by the writer with it in more favourable conditions are quoted in Table III. They speak for themselves quite clearly.

### GENERAL CONCLUSION.

The results of the investigations of the Shadowgraph test made by the writer show that its sensitiveness in practice is as high as its underlying principles suggest should be the case. As a consequence of his study and investigation of it, the writer has formed the opinion that the Shadowgraph test rests on a sound scientific basis, and is convenient and trustworthy in use. He considers that the technical staff of the Davis Gas-Stove Company are to be warmly congratulated on having devised so simple, yet sound and reliable, a test of the escape of products of combustion from the front of gas-fires. The uses of such a test to the designer, the manufacturer, and the purveyor of gas-fires, and to authorities on hygiene are obvious. It is beside the purpose of the present article to discuss in what, if any, circumstances a gas-fire which allows products of combustion to escape in front may legitimately be considered as conforming with the requirements made of a hygienic means of heating at the present day. But in a subsequent article the writer hopes to deal with some points, suggested by his investigations of the Shadowgraph test, which have an important bearing on this wider question.

## REPAIRS AND MAINTENANCE IN GAS-WORKS.

### PART III.

By a WORKS ENGINEER.

### PAINTS AND PAINTING.

THE painting of various parts of a gas-works is, if done adequately, a fairly heavy item. In some works, it is customary to put labourers on such work, but there is little doubt that it is a bad practice. While there may be one man who will do the work conscientiously and well, there will be a score who will scamp the work—not intentionally in many cases, but simply through ignorance. It is almost impossible to impress on an unskilled labourer the importance of thoroughly cleaning the work before applying the paint. It may be convenient, and it may be very altruistic, to keep the winter hands at work with painting during the summer months, but it does not pay. The work may be done as cheaply, but not nearly so well, as when an experienced man is employed to do the job. Far better is it to employ regularly one, two, or three men, according to the size of the works, on painting work throughout the year. There is always an abundance to be done under cover during wet weather, provided that the outside work is done on fine days. A trained painter, regularly employed, will do the work well on piecework terms, with a reasonable amount of supervision, as he will realize that the results of bad work on his part will soon be disclosed.

It is very difficult to choose suitable paints for the great variety of work to be met with in a gas-works. The writer, for some time past, has made a practice of using several different kinds of paint for each job, care being taken to match the colours, and to note the amount of paint used for a given quantity of work. In this way each paint is put on its trial, and it is surprising how much more material one paint will cover than another of similar appearance. It is also surprising how few paints are suitable for the bad parts of a gas-works. Retort-house cellars (where coke-quenching and clinkering are done), purifying-houses, coal-stores, washers and scrubbers, and pipe-work in close proximity, are all severe tests for a paint. The writer had much difficulty in finding a suitable paint for the roof principals of a purifying-house in which oxide was revivified, and where there was no draught and little ventilation. In this case eight principals were painted, each with one coat of a different variety. Within six months seven of the eight showed signs of rust, while the eighth, which was tarred—the tar first being boiled and applied cold—showed no signs of wear. Since that time, the roof has been tarred and has given no more trouble.

To emphasize the covering properties of diferent kinds of paint, the following figures from the above experiment will show how much they vary.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | pints | weighing | 11 | lbs. | of | No. 1 | paint | was used on | Principal A |
| 5½ | ,, | ,, | 8 | ,, | | 2 | ,, | ,, | B |
| 6 | ,, | ,, | 6½ | ,, | | 3 | ,, | ,, | C |
| 6 | ,, | ,, | 7 | ,, | | 4 | ,, | ,, | D |
| 7 | ,, | ,, | 11¾ | ,, | | 5 | ,, | ,, | E |
| 8 | ,, | ,, | 8¾ | ,, | | 6 | ,, | ,, | F |
| 4 | ,, | ,, | 5½ | ,, | | 7 | ,, | ,, | G |
| 8 | ,, | ,, | 9 | ,, | of | tar | ,, | ,, | H |

It is obvious from the above that due regard should always be paid to the covering properties of a paint before a purchase is made. For the protection of ironwork in such places as retort-house cellars, many engineers have now wisely adopted the practice of covering the ironwork by concrete or brickwork. This is a necessary precaution, if a long life is to be obtained for the ironwork, even though painted every year. It saves the cost of painting, and immeasurably increases the life at little expense. The writer has found it better to use brickwork for building in the joists, as there is more danger of the concrete coming away from the joists unobserved. In the writer's works tar is always given a good trial against other paints, and is often found to be the best where the conditions are worst. The cost of material, where appearance is not a great consideration, must of course be taken into account when arriving at the relative economy of using paint or tar.

A very useful type of paint has now been placed on the market for use in bad places, such as coke-cellars and ventilating-shafts in railway stations. This paint has a thick appearance, and seems to penetrate the iron, and it is applied in one coat. It never entirely dries and is always tacky, which property allows it to expand and contract, without either blistering or cracking. It is, of course, not suitable where material such as coal is stored against the ironwork, nor where men's clothes would come in contact with it; but for many purposes it is a distinct acquisition. It is also suitable for painting in damp places, or even under water.

Generally speaking, the writer is convinced that cheap paints are very little good; and, considering that the labour costs are identical whether an expensive or a cheap paint is used, it is not difficult to prove that the expensive paint is almost invariably much the cheaper in the long run.

### DRIVING BELTS.

So many types of belts can now be obtained for driving purposes, that it is difficult to particularize; but speaking generally, it is far preferable to use single belting wherever possible. Double belting is, of course, suitable for use on large pulleys, and is essential where the power to be transmitted is very high for the width of the pulleys in use. It is, however, possible to procure extremely strong double-tanned single belting made from chrome leather, which has been retanned with oak bark, and is as strong as double belting of ordinary leather.

The advantage of single belting is that it is so much more flexible than double belting—being less liable to slip, especially on small pulleys, and owing to the grip it obtains on rounded pulleys. A single belt accommodates itself to the shape of the pulley, and is thus able to transmit more power than is the case with double belting, provided, of course, that it is stretched sufficiently tightly. The writer uses double-tanned leather belting, and has found it to be extraordinarily strong, and to possess exceptional wearing qualities. Double-tanned belting possesses a strength in the fibre of 1330 lbs. per square inch, whereas in the case of the best oak-tanned belting it is only 660 lbs. The leather produced by this double tanning has all the advantages of chrome—notably, extreme suppleness and enormous strength of fibre. And yet in consequence of the retanning with oak-bark, the drawback of the stretching in chrome leather is totally overcome.

The proper care of belting is so often neglected that a few general points of importance may be mentioned:

1.—Do not use sticky dressings; and especially avoid resin. The best dressing is a mixture of animal fat and fish-oil or commercial lard.
2.—If belts are too dry, use a dressing; but if too greasy, extract the grease by washing with naphtha or packing the belt in sawdust.
3.—Examine belts periodically, and ensure that all driving surfaces are kept clean.
4.—Keep belts at a uniform tension, and true-up shafting if not in line.

It is often a good plan to cover a pulley with leather, and thereby save slip and friction losses. This is a good tip where an engine is working on its maximum load with no margin. In such cases, much advantage may be obtained. Well made balata belt is also excellent; but in the writer's opinion it cannot compare with the special leather belting mentioned above. In one recent case, balata belting was found to be very unsuitable, and that was for driving a dynamo used for generating current to supply De Brouwer machinery. In this case the load, especially when discharging filled-up retorts, varies to such an extent, that the dynamo often nearly pulls up; the result is that the belt slips on the pulleys, causing so much friction, that a balata belt was worn out in eighteen months. Balata belting will not stand exceptional wear of this sort, more especially as excessive friction generates so much heat that the solution speedily gives way. Rubbing on the side of a balata belt is disastrous to its wearing properties; and where such wear exists, the adoption of some other type of belt is essential.

### GUN-METAL CASTINGS.

The question of the metal used in making gun-metal castings is a matter of some importance. In this case, the most expensive metal in use is often the cheapest, as, when the cost of machining and grinding-in cocks is considered, the few extra pence per pound paid for a superior metal is money well spent, and saves a much larger amount, that would otherwise be spent in buying new castings and in labour. No engineer can go wrong in specifying a mixture of 89 per cent. of copper and 11 per cent. of tin. This makes excellent castings for all classes of good work. The scrap from these castings should be kept separate, and sent away to the foundry to be used again for the same class of castings.

The writer has always found delta metal excellent for its durability, and in one case its property—the No. IV. alloy—of resisting acids was the means of curing a most troublesome pump, which was continually requiring a thorough overhaul of valves and seatings. In this case, the pump was used for circulating the liquor in a water-gas plant. This liquor, being acid, is particularly corrosive, and is very destructive to ordinary gun-metal. A new set of valves and seatings would last no longer than six weeks,

and long before this time was reached, the pump could be seen running at three times its proper speed, in order to cope with the requisite quantity of liquor. The writer calculated that this pump was costing no less than £40 a year for wear and tear. A complete cure was the substitution of delta metal for gun metal.

### Repairing Shops.

In a gas-works of moderate or large size a good machine shop is a necessity, so as to provide adequate facilities for dealing promptly with breakdowns. This aspect of the question need not be discussed in an article on wear and tear. Apart from its usefulness in this direction, it is a good money-saver, and should enable very considerable economies to be made in the wear of all machinery. It is usually possible to make the various parts of an engine or machine for one-half the amount charged by the makers for spare-parts. It is, of course, necessary to employ a pattern-maker, or at least a carpenter with a knowledge of the trade, and also a smith who can turn out good machine forgings and machine tools. Otherwise the advantages of a machine-shop will be considerably curtailed. For a medium-sized gas-works two lathes—one large and one small—a small planing-machine, a radial drilling-machine, a pipe-screwing machine to take up to 4-inch pipes, a cold saw, a shearing and punching machine, and an emery-wheel, are all that are necessary.

### Cocks and Valves.

It is false economy to buy cheap valves and cocks; they invariably give trouble sooner or later, and, as often as not, they are the cause of Sunday work with its additional expense. So many valves and cocks cannot be disconnected, except when the plant is shut-down, that it is decidedly advisable to provide facilities for testing all cocks and valves at suitable pressures before paying for them. It is surprising how many are defective, even before being put to work.

### Renewal of Pipes.

In renewing underground pipes, it is a wise plan to consider whether it would not be better to replace them by overhead pipes, so that all leaks can be readily detected. So many leaks underground go on undetected for years that there should be no two opinions on the matter. An alternative plan is to lay the pipes in trenches covered with removable plates. The question of the respective merits of cast-iron and wrought-iron piping is another matter which requires attention at times of renewal. Both types have their advantages and disadvantages, and it is impossible to lay down any law on the subject. With overhead pipes, the writer invariably insists on them being laid at a sufficient distance from a wall, or other support, to enable the pipe to be properly painted. This is a common fault, and should not be allowed.

### Water for Hydraulic Use.

Where much hydraulic machinery is in use, a good deal of wear and tear may be saved by fitting a suitable filter on the suction side of the pumping-engine, so that all return water must percolate through the filter before being again used. The writer has found that this water commonly contains about 15 grains of solid matter per gallon; and as a certain amount of grit is bound to be present, it is very desirable to remove it. Trouble no doubt arises from rust on the inside of the hydraulic pipes, especially in the case of pipes which are used at irregular intervals, and also in the case of new ones. It is a good plan to paint hydraulic pipes internally before using them.

### Boiler Feed-Water.

Similarly, much wear and tear on boilers may be saved by using pure water. It is usually impossible to obtain such water without softening it chemically; but money spent on an efficient system is very well invested. The proper preparation of boiler feed-water is an interesting subject, but would be a digression in an article of this sort. Given pure water, it is possible to save much expense on the removal of scale, by obtaining a longer life from the furnace tubes and in the saving of labour in patching the tubes and in the renewal of leaking rivets. Less wear and tear on all the fittings of the boilers, together with the advantages already named, will amount to a large item each year.

### The Use of Old Fire-Bricks.

The wear and tear of fire-clay materials and retorts is too large a subject to receive any attention in an article of this sort—it is a matter which would call for individual treatment. Before, however, leaving the subject, the writer considers that a large sum of money might be saved if more attention was paid to the cleaning and re-use of the old fire-bricks. An old fire-brick is as good as a new one; and there is no reason why a new setting should not be constructed entirely of old bricks. The writer always insists on this being done, with the result that much money is saved, very few new bricks are required, and the setting is for all practical purposes as good as if built with new bricks. Bricklayers are prejudiced against the use of old bricks, as it means more trouble for them; but if the supply of new bricks is purposely limited, the use of the old ones is inevitable. When pulling down the old settings, a careful watch is kept to ensure that no good bricks are removed with the broken material. The writer has never yet had reason to regret this practice.

### Second-Hand Material.

In buying joists, angles, and tees, there is a good deal of economy in picking up second-hand material at about half the price of new stock. It is frequently as good as new, and when covered with a coat of paint would be indistinguishable. Joists are so frequently used in connection with concrete, the steel sections being embedded in the latter, that, provided the material is sound, there is no possible objection to its use on this class of work, even on the score of appearance. Plates and bars are not so often procurable as second-hand material.

## A PROGRESSIVE FIRM.

**Extensions at the Elland Works of Messrs. Robert Dempster and Sons, Limited.**

On the occasion of the inauguration of the new fitting shop, new tinplate shop, and general extensions at the Rose Mount Iron-Works, Elland, Messrs. Robert Dempster and Sons, Limited, on Wednesday last, issued invitations to a number of gas engineers from Yorkshire, Lancashire, Cheshire, and Derbyshire.

The visitors were very warmly welcomed by the Managing-Director of the Company, Mr. J. W. Broadhead, who was indefatigable in his efforts to ensure their comfort. Accompanied by Mr. Broadhead, a thorough inspection was made of the new works; and on all hands one heard the highest praise and appreciation of Messrs. Dempster's enterprise in carrying out their extensions. One was interested to hear that the whole of the new buildings have been erected by the firm's own workmen; and appreciative reference to this fact was made later in the day, when the party adjourned, after the inspection, to the Elland Constitutional Hall, where dinner was served.

The principal extension consists of a new machine and fitting shop. This building is 218 feet long by 97 feet wide, and consists of three bays. One bay is fitted with high-speed machines for light work—the machines for dealing with heavy work being placed to the side of the large central bay, to enable the 5-ton overhead electric crane to handle the material. The other bay is utilized principally for fitting and bench work. This shop is heated by steam and hot-water apparatus, and lighted by the Textile Illuminating and Engineering Company's high-pressure gas; the lighting being very efficient, and giving the most satisfactory results. This shop is practically full of apparatus of every description in course of construction—confirming the information given to the visitors that the firm are exceedingly busy. A special overhead track has been put up for testing and adjusting Messrs. Dempster's patent telphers before they are sent out, and also a transforming plant to enable adjustment of the Elland electricity supply voltage to suit different test requirements.

Many of the visiting engineers were interested in seeing "Sumner's" patent vertical mechanical washer at work. This consists of a series of circular trays, in which the liquor is agitated and sprayed in fine quantities by means of revolving paddles, and the whole of the gas is compelled to pass through many fine sheets of water—thorough scrubbing being obtained without "slip," and without causing any back-pressure. The apparatus is extremely simple, and looks likely to be a strong competitor of similar appliances already on the market. Coke discharging machines, Everitt's patent tar-fog extractor, the "Simplex" vaporizer, and Dempster's patent connectionless valve for purifiers in square and other apparatus were items attracting interest. The whole of the works, except the electric cranes and a few special machines, are driven by gas-engines.

The next addition to the buildings is an overhead template floor, providing covered ground space underneath. It is 140 feet long by 40 feet wide, also suitably heated and lighted by incandescent gas. Here the whole of the gasholders and other constructional ironwork are drawn out full size on the floor, and wood templates are taken from the drawings thus made, from which the bars, plates, &c., are marked for punching, drilling, shearing, bending, &c., as the case may be. The planing shop, which formed part of the old fitting shop premises, has been retained, extended, and a new large planing machine with the Lancashire electric drive added. The rest of the old fitting shop has been converted into a valve and general store and paint shops.

The visitors inspected the foundry, where they were able to see, among other things, hand and machine moulding, and large loam mouldings. The foundry is fitted with two travelling cranes—a 20-ton electrically driven, and a 10-ton rope-driven one. The extensive gasholder and structural iron departments, which are full of up-to-date machinery of every description, proved a great attraction. It was stated that this department has been exceptionally well employed for several years, mostly on spiral-guided gasholders and steel tanks. The output of conveying plant is great; every description being constantly under contract.

Several oxy-acetylene plants were seen in operation (cutting and welding). Three loco cranes convey materials to the different departments. The works throughout appeared extremely busy, no less than 860 workpeople being employed at the present time.

Mr. E. J. King (one of Messrs. Dempster's representatives), in proposing the toast "The Gas Industry," referred to the centenary of "that great London Company, the Gaslight and Coke Company." It would, he thought, be startling to those who knew little about gas matters to find that one of the earliest gas companies had already completed a hundred years' service, and that amid great rejoicings. The gas industry, in its initial stages, was formed on very crude lines; and it was

only by gradual progress through the years that the perfection of the present day had been attained. There was a period—about thirty years ago—when gas seemed to be in a state of stagnation—perhaps fearing the possible competition of electricity. But opportunely for the gas profession was introduced the incandescent mantle, by which means the industry had continued to more than hold its own. The mantle had been improved upon continuously; high-pressure lighting such as one saw in go-ahead towns, and in Messrs. Dempster's fitting-shops, being sufficient to answer any disputation as to the comparative effects of gas and electricity. While lighting apparatus was being improved in the manner he had indicated, they should not forget that there had also been gradual progress in the application of gas for heating and cooking. The industry acknowledged and thanked those who, by research work at the Leeds University, were, to some extent, instrumental in effecting improvements in modern gas-fires. Another great source of supply was for power purposes. Gas-engine manufacturers had, therefore, also progressed; a multiplicity of sizes and designs being now installed in all parts of the country. But reductions in the price of gas to all classes of consumers had only been achieved by the care which was now exercised in up-to-date management of works—an economy which was partially due to the suppliers of apparatus, and to contractors such as the firm that he had now the honour to represent. Then, again, by improved methods of carbonization, and by the invention of labour-saving machinery (such as charging and discharging machines), labour in the works had become cheaper and the work less onerous. Labour conditions were, nowadays, altogether superior to what they were twenty years ago. Hours had been shortened, and Sunday labour was to a large extent being abolished. After referring to the "fine spirit of co-partnership" which existed in certain undertakings, he said it redounded to the credit of the employers, and was responsible for the present friendly conditions between master and man. They should not forget that the gas industry was a vast one and was headed by an Institution—a body composed of brilliant engineers and scientists. Outside the Institution, there had been formed, during the last eight or nine years, the Society of British Gas Industries, which was, in the speaker's opinion, composed of an equally brilliant body of men attuned in scientific research. This body was founded, not in opposition to the Institution, but to voice opinions on gas matters generally. They had recently seen the formation of the British Commercial Gas Association, which had joined together many men who met on the same ground, to the advantage of the gas industry and all concerned. He coupled with the toast the name of Mr. Shadbolt, who, by his hard work, zeal, and energy, had had a very successful year in his recent term of office. Mr. Shadbolt was largely instrumental in the formation of the British Commercial Gas Association. It was a body that the industry felt the need of, and one that some years ago was little dreamt of.

Mr. R. G. SHADBOLT, replying to the toast, remarked that Mr. King had touched upon the value of organization in the gas industry. At one time, if one spoke of "the industry" the inference was that it referred to a certain section; but to-day when they spoke of "the industry," they meant the allied industries connected with the manufacture and distribution of gas. He could not help thinking, as he traversed Messrs. Dempster's works that afternoon, how utterly misguided was the correspondent of a London daily paper who recently took upon himself the task of criticizing the gas industry. By insinuation, this "critic" said the gas profession was not to be compared with "an industry of more recent growth"—he supposed that the "critic" referred to electricity. Those present knew—and the public knew—the value of gas for all purposes. The "critic" had since admitted that he misjudged the gas industry, because, had he known that it had grown from such small beginnings, and had now reached the stage which Mr. King had referred to, he would not have been so tempestuous in his statements. Doubtless if this rash "critic" had been present with them that afternoon and had seen the scientific methods which were brought to bear at Messrs. Dempster's works, he would have been the first to admit that the gas industry was in the van of scientific progress and principles for the use and betterment of their fellow-men. The gas industry was whole-minded in its present policy of development on broad lines. They, as behoved men who were connected with modern applications of gas for all practical purposes, insisted on instilling these ideas into the people who would not come forward into the progressive van. A gas manager who sat in his office and expected orders for services to be brought to him, was not, in his opinion, a gas manager. Again, this sort of a gas manager could not hope to keep himself in the van unless he considered that his undertaking's interests were identical with those of manufacturers who were able to supply the apparatus to which the commodity they were all interested in could be most profitably applied. As to Mr. Broadhead, they knew he was a candid friend to the gas industry, and that by plain statements of fact and explaining methods of producing gas apparatus in all its ramifications, he (Mr. Broadhead) was only receiving the reward which was his due. The gas industry understood that its first duty was to the public. He would like it to go forth from this assembly, through the Press, that the gas industry to-day, in all its ramifications, was fully alive to its privileges and responsibilities and obligations, and would meet them to the uttermost. An industry which had been established for a hundred years or more did not blush as to its past career, or past misjudgments, but relied upon the energetic movement which was now the basis of future procedure; and they would do even better than before. He thought the public were beginning to realize that gas was one of the greatest labour-savers that had ever been brought into civilizing action for the benefit of the community. The gas scheme was a great one, and it was one that could be substantiated at every point.

Proposing the toast of "Robert Dempster and Sons, Limited," Councillor F. HOLROYD, J.P., coupled with it the name of Mr. J. W. Broadhead. He said the works inspected that afternoon reflected the greatest credit upon the management and workpeople generally. The name of the town of Elland was known in almost every part of the world—in fact, if Dempster's had not been in Elland, very likely Elland would not have been there that day. Most of them knew that the firm had grown remarkably fast. He remembered Robert Dempster's when it was nothing like the firm of the present day. A little over twenty years ago, the staff in the office consisted of six men, and the total number of workmen was under 100. Now, owing largely to Mr. Broadhead's efforts, the staff numbered 55 and the workmen nearly 1000. He believed that wherever gas was made, the name of the firm was known; the number of repeat orders which the firm received being eloquent testimony to the way they carried out their work. In conclusion, he alluded to Mr. Broadhead's indomitable energy in the interests of the Company, and said all present acknowledged his worth. He hoped that the success which had been the firm's in the past would be greater and greater in the future.

The toast was heartily received with musical honours.

Mr. BROADHEAD, in reply, thanked Councillor Holroyd for the very kind way he had spoken of the firm which he had the honour of controlling, and for what he had said about himself. This was the second occasion that he had had the privilege of welcoming so large an assembly in connection with extensions at the Rose Mount Iron-Works. The first was when they celebrated the opening of their new offices; the present one, as they were aware, was in connection with the new extensions of which the fitting and machine shops formed the principal part. So rapid had been the growth of the business, that the Directors began to tire of making piecemeal extensions which did not meet their requirements for long, and so determined to make the very extensive alterations and additions which had been inspected that day. He did not intend to go into details about the new buildings, which, by the way, had been designed by their own staff, and executed by their own workmen. Suffice it to say that all connected with the firm felt very proud of the extensions. All parts of the works were fitted with modern labour-saving appliances, which he trusted would not only enable them to turn out work cheaper and better, but would permit the employees to work under even better conditions and surroundings than they had had in the past. As a matter of fact, they had additional new machinery on order at the present time, with a view to bringing to an end, if possible, the chronic state of overtime which had prevailed in the works for the last few years—overtime which was neither good for men nor masters. After remarking that there was money to be saved by gas undertakings placing their orders earlier than was usual in the profession, he went on to say that the advantage in the deal was mainly on the side of the buyer, because a firm who were normally employed during the whole of a twelvemonth were able to turn out work far better than a firm who were "rushed." He was sure they would excuse him for the personal pride he took in the progress of Robert Dempster's—progress, he was glad to say, that had been achieved without poaching on others. Other members of the staff had reason to share in this pride; and he was greatly indebted to them. Dealing with the expenditure necessary for research and other work, he said that during the last few years the Company had spent a large amount of money in experimenting with vertical retorts. As to the work accomplished during the year, among the spiral gasholders completed was a 3½-million cubic feet four-lift holder for Belfast; and within the last fortnight they had fully inflated and handed over to the Oldham Corporation, without the slightest hitch, a similar guided holder of 5½-million cubic feet. They were proud of this accomplishment, because the holder was the largest of its kind in the world. Of late years, the transporting department had made great strides—so much so, that it became necessary to appoint some one to take charge of it. Under the guidance of Mr. Brooks, who was an expert in this branch, the firm had turned out during the last two years twenty-seven telphers, principally for handling coal and coke and warehousing goods. A special overhead track—as they saw that day—had been put up in the works for testing and adjusting the telphers before they were sent out to customers. Some of them might wonder how the works came to be started in Elland. It was this way: About 58 years ago, Mr. Robert Dempster, senior (who, by the way, had just celebrated his 84th birthday, and, he was sorry to say, was just now not in the robust health they would like him to be), was Manager of the Elland Gas-Works. In those days, every large manufacturing firm in the district—and there were many of them—had gas-works of their own. Mr. Robert Dempster came to the conclusion that anyone with a knowledge of gas making such as he possessed had a field before him which looked like promising a rich harvest; and he, in company with Mr. Butterfield and Mr. Bentley, commenced business as gas-plant manufacturers in Elland—specializing in retort-settings. He (the speaker) had in his office at the present time a circular dated 1857, bearing their name. In it they spoke of retorts from 2 to 5 feet wide; but no depth was given. Some time after that, Mr. Robert Dempster commenced business on his own account, with what success they all knew. The progress of Robert Dempster and Sons during the latter years had been coincident with that of the gas industry itself. He welcomed the extensions they had been able to make from time to time to their works, not merely on account of the additional grist brought to the mill, but because of its healthy and consolidating influence on the gas industry generally.

In proposing the toast of "The Staff of Robert Dempster and Sons, Limited," the CHAIRMAN paid eloquent tribute to their unselfish labours for the success of the Company, and assured them that they were heartily appreciated by the Directors. Mr. C. T. JACOBS, the Secretary, responded.

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A joint meeting of the Southern and South-Eastern District Divisions of the Institution of Municipal Engineers will be held at 4, Southampton Row, W.C., on Wednesday, the 27th inst., when a paper on "The Effect of Recent Decisions upon the Arbitration Clause" will be read by Mr. Valentine Ball, M.A., author of "The Law Affecting Engineers." The subject is of importance to engineers and others engaged in municipal work.

At a joint meeting of the Western and North-Eastern District Commercial Sections of the North British Association of Gas Managers held in the Heriot-Watt College, Edinburgh, on the 1st inst., Mr. James M'Leod, the President of the Association, in the chair, the following resolution was passed: "That this meeting very heartily approves of the aims and objects of the British Commercial Gas Association, and strongly recommends its members to give it their practical support."

# RECOVERY OF BENZOL FROM COAL GAS:

## ITS USE AS A MOTOR FUEL.

By G. Stanley Cooper, B.Sc., F.C.S.

During the last few years, the demand for all tar products has been very strong indeed; and there is every likelihood that the present high prices will be maintained for a considerable time. In all probability, the use of refined benzol as a motor spirit will be quite general before very long; and this fact, together with the ever-increasing consumption in other directions, renders the present a very opportune time for colliery owners to instal benzol recovery plants in connection with new or existing installations of bye-product coke-ovens. The first cost of such a plant is not high; the working cost is exceptionally low; while the results obtained from a good plant enable such an installation to be a very profitable one.

The method of recovering the benzol from the coke-oven gas is practically the same in all types of plant; the only difference being in the apparatus employed. The crude gas from the ovens is partially cooled, and the tar and ammonia extracted. The latter operation is carried out at a temperature of about 50° to 70° C. Before benzol can be recovered, it is necessary to cool the gas down to about 20° C. The gas then passes up scrubbers down which a stream of creosote washing oil is flowing. This oil is capable of dissolving out of the gas all the constituents which go to make up what is commercially known as crude, or "50 per cent.," benzol—viz., benzol, toluol, xylol, cumol, anthracene, naphthalene, &c. To obtain the best results, it is important that the washing oil used should be of a quite suitable character. This is tested by a fractional distillation of the oil concerned; and the following is a specification which is generally accepted as being among those most suitable for the purpose:—

| | |
|---|---|
| Density | 1·03 to 1·05 |
| Distillate up to 230° C. | 5 to 15 per cent. |
| ,, ,, 300° C. | 70 to 80 ,, |

The quantity of naphthalene must not be excessive—usually not more than 10 to 20 per cent.; and the oil must not contain any water. Too much importance cannot be attached to the proper choice of the washing oil, as with an inferior oil loss can so easily take place in many directions. Among others, the following may be mentioned as some of the principal causes of loss due to the employment of inferior oil: (1) The oil does not possess the necessary solvent power to extract all the constituents of benzol; hence the maximum yield is not obtained. (2) The oil contains a large proportion of constituents which boil at a low temperature; hence much loss by evaporation occurs, and the washing oil has to be replaced more frequently than would otherwise be the case. (3) Certain classes of oil require more steam in order to distil the benzol from the oil. This is particularly so when the oil used is too heavy.

After the gas has been thoroughly scrubbed by the washing oil, and the whole of the benzol thereby extracted, the latter is recovered from the washing oil by the following process. The rich oil containing the benzol is run into collecting tanks, where its temperature is about 20° C.; and from there it is pumped into a preliminary heater, where the temperature is raised to about 40° C. to 50° C. It then goes to the superheater, where, by means of a steam-coil, the temperature of the oil is raised to about 130° C. to 140° C. The superheated oil then passes into the still proper, and is now subjected to distillation by means of live steam at a temperature of about 105° C. In this way, the whole of the benzol is removed from the washing oil, and the vapours pass away into coolers. It will now be seen that it is important that the constituents of the washing oil should all have a boiling point considerably above 150° C.—*i.e.*, well above the maximum temperature to which the rich oil is heated.

The vapours which leave the still consist of benzol and a certain proportion of steam. These are condensed in coolers, and the two liquids separate owing to the difference in their densities. The debenzolized oil passes out at the bottom of the still through a series of water-coolers and then into the storage tanks, to be used again for scrubbing purposes. It is essential that the oil should be thoroughly cooled before being employed again in the scrubbers. The temperature should not exceed 20° C., as above this point the scrubbing is not carried out efficiently, and consequently benzol is lost.

The benzol obtained by the above process is a very crude product, and is usually known as 50 per cent. benzol—*i.e.*, when distilled 50 per cent. of the liquid passes over below 100° C. In some cases it is found desirable to prepare a purer product—90 per cent. benzol. To accomplish this, the 50 per cent. benzol is redistilled at a temperature of about 105° C. The terms 50 per cent. and 90 per cent. benzol are approximate, and serve commercial purposes only. Laboratory tests are carried out by the makers in order to test the standard of their products; and it is unfortunate that in England no uniform test exists for laboratory purposes. Hence differences between buyer and seller often arise. On the other hand, in Germany a standard apparatus is employed.

The vital points in these tests are the position of the thermometer and the size of the distilling vessel, particularly the former. The usual practice in England is to have the thermometer bulb dipping into the liquid; while in Germany the bulb is kept in the vapour. The writer has performed a series of experiments with the same apparatus (I.) with the thermometer bulb in the liquid, and (II.) with the thermometer bulb in the vapour. The following table shows the difference in the results obtained thereby.

| | I. Per Cent. | II. Per Cent. |
|---|---|---|
| Distillate to 100° C. | 49 | 66·5 |
| ,, ,, 120° C. | 69 | 76·0 |
| Remainder at 120° C. | 29 | 23·5 |
| Loss | 2 | 0·5 |

If, further, the benzol is distilled, using a fractionating column, the proportions distilling over at 100° C. and 120° C. respectively are further increased. It is highly desirable therefore that some scientific standard of testing should be universally adopted.

Much has been heard lately of the use of benzol as a fuel for motor purposes, and it has been suggested that the gas-works should take up the production of this fuel for purposes of supply. In the opinion of the writer, such a state of affairs is not likely to happen for various reasons. The illuminating power and calorific value of the benzol constituents in coal gas are too valuable to be dispensed with very readily. The standard of the gas would be lowered to such an extent by removal of the benzol that recourse would have to be had to some system of enriching. In other words, it would be a case of robbing Peter to pay Paul. Again, only very few gas-works are large enough to warrant the installation of a benzol plant—that is, a plant run on profitable lines. By the best methods, and with the best coal, 2½ gallons of benzol per ton of coal carbonized may be reckoned as the maximum yield obtainable. A limited production would not allow of the marketing of the product at anything like competitive prices.

If benzol is coming, it must come as a bye-product from coke-oven installations. Some writers have recently referred to benzol as a product of coal tar. So it is, but only to a very limited extent. It is by the process outlined above that the bulk of the benzol is obtained, and at present the process is confined to coke-ovens. There are in this country numerous installations already at work producing benzol; and if the demand is sufficient, no doubt many more benzol recovery plants would be erected. The spirit which is suitable for motor purposes is that described as 90 per cent. benzol; and when properly prepared and used it is superior to petrol in many respects. It has a higher calorific value than petrol, and at the same time a higher specific gravity —·880 as against ·775 for petrol. Consequently, more air is necessary for the perfect combustion of the benzol than is required in the case of petrol.

With regard to the question of price, benzol is at the present time in great demand, and costs about 10d. to 11d. per gallon for the redistilled spirit. This price is a good one, and allows a fair margin of profit to makers. Possibly, of course, as the demand increases the price may rise considerably; and this, together with the possibility of a Government tax, would tend to equalize the advantages of the two fuels.

# CHEAP GRADE MANTLES.

In last month's number of "Gas Industry" [New York] the Editor, in his introductory notes, deals with this subject; and many of his remarks are quite appropriate to the condition of affairs in England.

He writes: Since it is a fact that the tendency on the part of some of the gas-mantle makers is that they may live for the day at the future expense of the gas industry at large, it is high time that serious consideration were given to the subject by the gas-men of the United States, in co-operation with those makers of incandescent gas-mantles who are determined to build not simply for to-day, but as well for the future, and are also of the live-and-let-live type. "Cheap" mantles look well and sell well; but they are as unhealthy for the trade as are green apples for the boy in the spring time. There will be commercial colic in the illuminating side of the gas trade if things keep on as they have been going of late; and then perhaps the stomach pump and all other means at hand will be found insufficient to overcome the malady.

Were the electric enterprise of the United States back of some of the mantle-factory enterprises of the country, the conditions could not be more to the liking of the electric light man, who is, no doubt, smacking his lips over the tendency to ruin the gas lighting trade at large. This he must have observed while his sleepy competitors, gas men (with some exceptions naturally), have simply dozed in a self-satisfied way, or have ignored the valuable illuminating side of their business in the exultation of having discovered new and added shop and kitchen uses for their product.

The "cheap" mantle is the canker-worm eating at the vitals of the gas illuminating industry. How long shall it be tolerated, or how soon will it be fought? . . . Just let a gas consumer get hold of, one after another, poor mantles; and then, at that most opportune moment, let the electric light solicitor call. What would you give for the chance of the gas man? Think it over seriously, and warn your consumers against "cheap" mantles.

His Majesty the King has been graciously pleased, upon the recommendation of the Secretary for Scotland, to confer upon the Chief Magistrate of the City of Glasgow and his successors in office for the time being the right to the style "The Right Honourable" prefixed to his official title of "Lord Provost."

# WOODALL-DUCKHAM CONTINUOUS CARBONIZING SYSTEM

AT THE

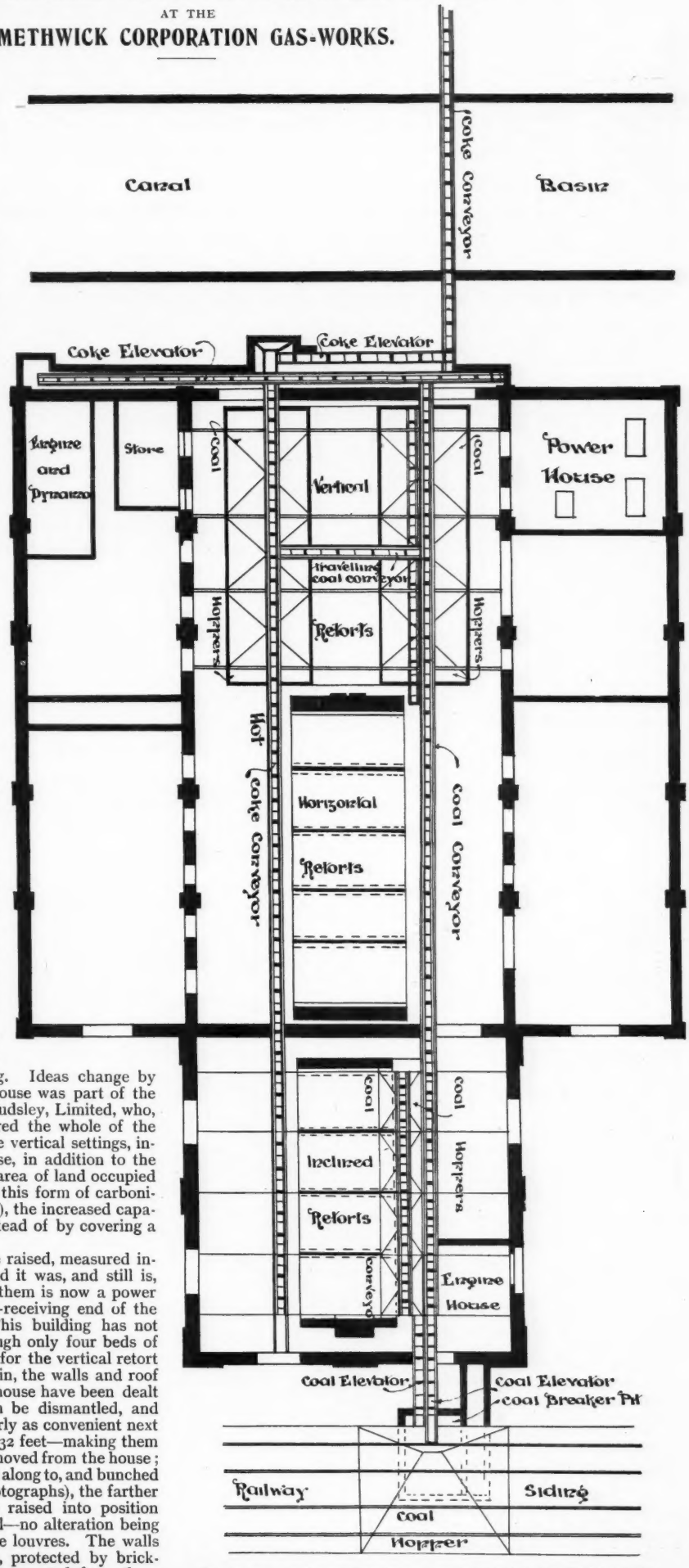
# SMETHWICK CORPORATION GAS-WORKS.

The Smethwick Corporation Gas-Works stand on historic ground for the gas industry. Hard by, at the very beginning of things for the industry, when all appertaining to it was in an inchoate form, Murdoch carried out much of the small but potential inceptive work that formed the seed of the flourishing and world-wide gas industry as we now know it. It is in the very fitness of things, therefore, that the Smethwick Gas-Works should be at all periods representative of the latest progress in gas manufacture. We have from time to time seen many changes at these works, under the enterprising technical counsel of the Corporation Gas Engineer (Mr. Vincent Hughes). There has been during his reign as technical adviser transformation of the carbonization process to those types that are of the best regenerative horizontal practice, and inclined retort working has also found its place there. Now to-day we see on the works, with thirteen months' continuous running to its account, an installation of the Woodall-Duckham continuous system of carbonization; and so healthy are the results from it, that the prospect is the final demolition of the horizontal settings and the entire abandonment of horizontal working will take place early next year. Those responsible for the Smethwick Gas-Works mean they shall be (as they ought to be, if only for their geographical relation to the scene of Murdoch's early work, and for no other reason), in the van of technical progress.

## The Old Retort-House Elevated.

However, we have to describe the work associated with the latest change in the carbonizing methods of the works, as well as incidentally allude to the prospective change. The retort-house to-day is a central figure in the works, and a building of some architectural pretensions standing among the huge squat structures of the great engineering firms in the neighbourhood. It is the old retort-house elevated (and, through its elevation, dignified), from design prepared by Mr. Hughes. We remember the house in its old days, when it sheltered only horizontal retorts. It was thought a nice building then; but the photograph of it as it was then, when compared with the photograph of what it is now, makes it appear relatively diminutive and uninteresting. Ideas change by comparison. The raising of the old house was part of the contract of Messrs. Duckham and Cloudsley, Limited, who, in fact, under the one contract, covered the whole of the work involved in the installation of the vertical settings, including the conveyor work. The house, in addition to the heightened productive capacity of the area of land occupied by the verticals, reminds us that, with this form of carbonization (apart from its greater efficiency), the increased capacity is obtained by going upwards, instead of by covering a larger superficial area.

The old house, before its walls were raised, measured inside 110 feet long, by 56 feet wide; and it was, and still is, flanked by coal-stores (part of one of them is now a power house), 27 ft. 6 in. wide. At the coal-receiving end of the house is the inclined retort-house. This building has not been altered in any way. But, although only four beds of horizontal retorts have been removed for the vertical retort installation, and five settings still remain, the walls and roof of the whole of the horizontal retort-house have been dealt with, so that the remaining beds can be dismantled, and their place tenanted by verticals, as early as convenient next year. The walls have been raised by 32 feet—making them 60 feet to the eaves. The roof was removed from the house; the main principals being merely shifted along to, and bunched together at (as seen in one of the photographs), the farther part of the house, and subsequently raised into position when the building work was completed—no alteration being made to the roof except a change in the louvres. The walls were carried up by steel stanchions, protected by brickwork and panelling—the roof being supported from these



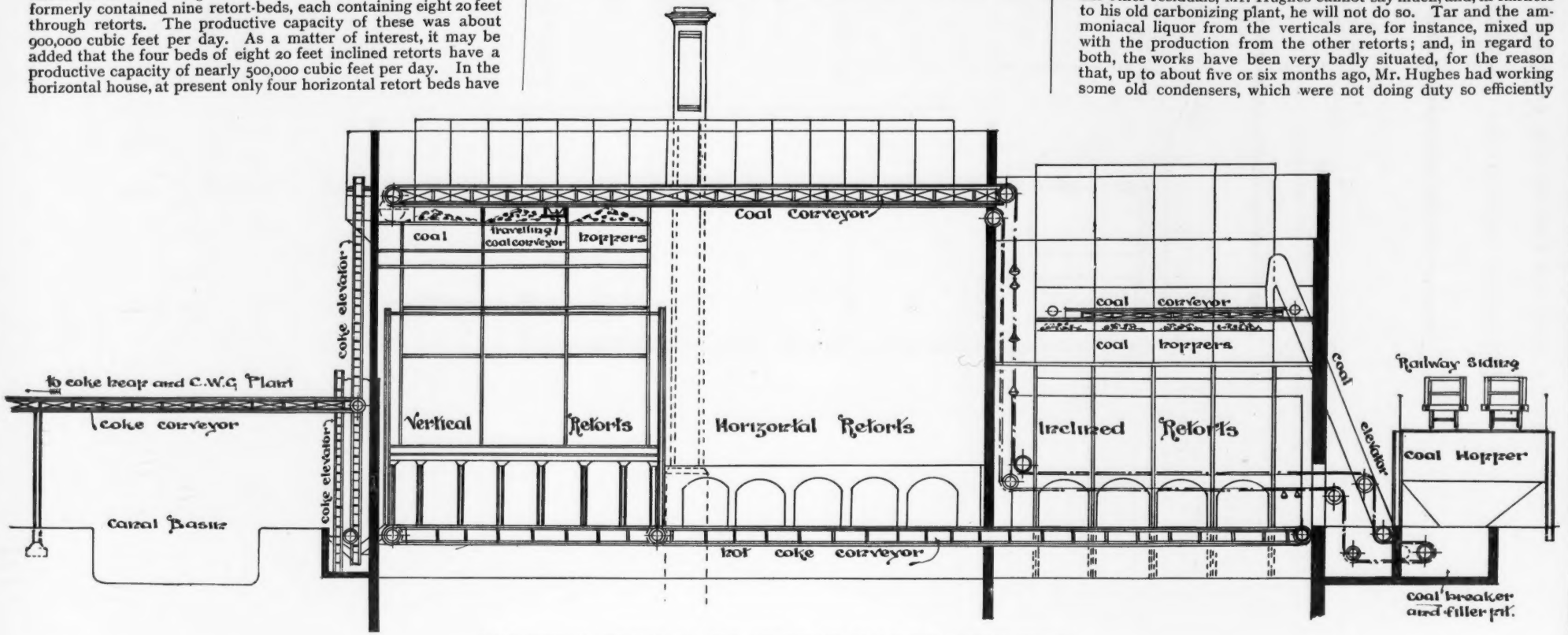

PLAN OF THE SMETHWICK GAS-WORKS RETORT-HOUSE.

stanchions. There was another reason why the walls and roof of the whole house should be raised simultaneously, and that was, in order that the whole coal-conveyor plant might be at once conveniently installed. This has been done; so that the coal-handling plant is ready for the extension of the vertical system. Among other structural work in connection with the building was the erection of two chimneys, each 98 feet high and 7 ft. 4 in. by 3 ft. inside measurements, as seen in certain of the photographs. These chimneys will also provide for the second installation. As mentioned, part of one of the coal-stores (as depicted on the first drawing, and shown in one of the photographs), has been converted into a power-generating house for driving the plant connected with the vertical settings.

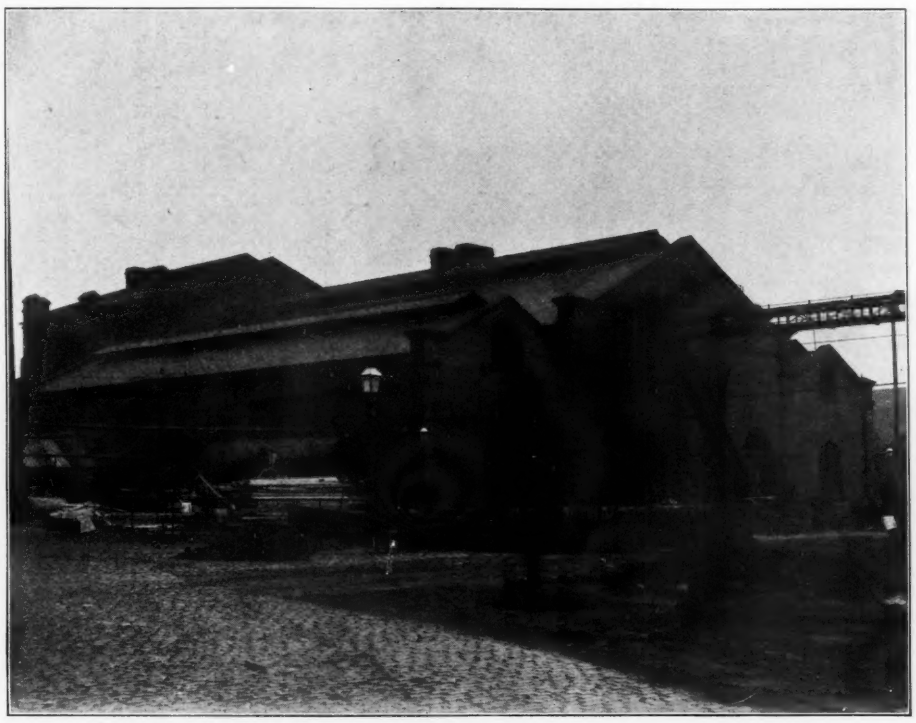
### The Old and New Gas Productive Capacities, and a Reference to Residuals.

It is interesting, before proceeding with the work of description, to note the vast difference in productive capacity that the change has made on the same ground area. The horizontal retort-house formerly contained nine retort-beds, each containing eight 20 feet through retorts. The productive capacity of these was about 900,000 cubic feet per day. As a matter of interest, it may be added that the four beds of eight 20 feet inclined retorts have a productive capacity of nearly 500,000 cubic feet per day. In the horizontal house, at present only four horizontal retort beds have been removed. In their place now stand six settings of retorts on the Woodall-Duckham system, in two parallel lines of three settings. With the four horizontal settings, some 400,000 cubic feet of gas could be produced per day. From the six beds of verticals—on the same ground area—Mr. Hughes can get upwards of 1,250,000 cubic feet, or about 350,000 cubic feet more than he could do from the entire house before. The guarantee of the contracting firm was that the six beds of verticals should carbonize 108 tons of coal per twenty-four hours; and the actual quantity is found to vary between that and 120 tons—depending not so much on the class of coal that is being used, as upon its condition. Up to the date of erection, this was, we believe, the largest installation of continuous verticals in England. It is a good report that Mr. Hughes gives as to the general conduct of the plant and of its productive results, though regarding the latter he cannot speak with any great exactitude quantitatively as to the residuals owing to present works conditions. But, speaking generally, under the old system of horizontals and inclines combined, some 12,200 cubic feet of gas per ton used to be made; now, on the average, with the verticals, from 12,700 to 13,000 cubic feet of gas are realized. Not much attention is paid at Smethwick in these times to the illuminating power of the gas. But a strict watch is kept on the calorific power; and this property is maintained at between 570 and 580 B.Th.U. gross.

As to coke, the distinction between that from the verticals and the horizontal and inclined working is very marked; and this is particularly seen as the coke is stored in barges lying in the canal basin on the works. The silvery and clean appearance of the vertical coke is such a contrast to the dull, heavy-looking coke from the other retorts that it is possible to pick the one from the other with the greatest ease. The coke is about 22 per cent. lighter than that from the other retorts. It contains little moisture, as it is merely cooled off in the closed chambers below the coke-extractor of each retort. Therefore the consumers benefit; and, as a matter of fact, the consumers have a strong preference for the vertical retort coke. As to the production of the other residuals, Mr. Hughes cannot say much, and, in fairness to his old carbonizing plant, he will not do so. Tar and the ammoniacal liquor from the verticals are, for instance, mixed up with the production from the other retorts; and, in regard to both, the works have been very badly situated, for the reason that, up to about five or six months ago, Mr. Hughes had working some old condensers, which were not doing duty so efficiently




LONGITUDINAL SECTION OF THE SMETHWICK GAS-WORKS RETORT-HOUSE.



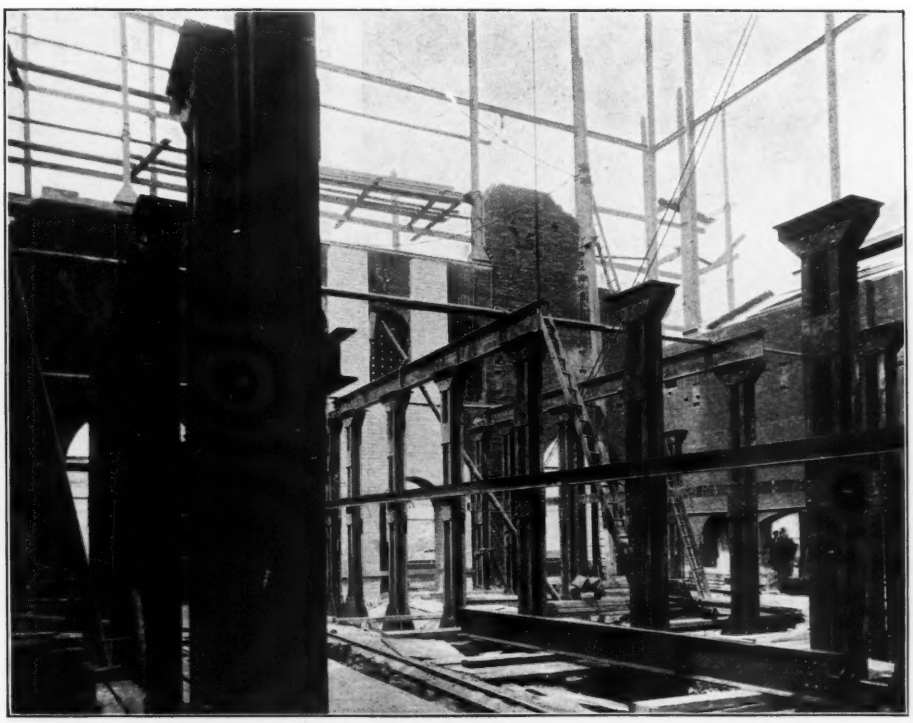
THE OLD HORIZONTAL RETORT-HOUSE AT THE SMETHWICK GAS-WORKS BEFORE RAISING THE WALLS AND ROOF.

as could be desired. Now new condensers are at work, tar is giving a good account of itself. Just at the present time, too, new sets of Holmes's washers are being completed. It will be seen from these facts and considerations that it would not be fair to the old carbonizing plant to compare it with the new, in respect of the secondary products, seeing that it was working at a disadvantage.

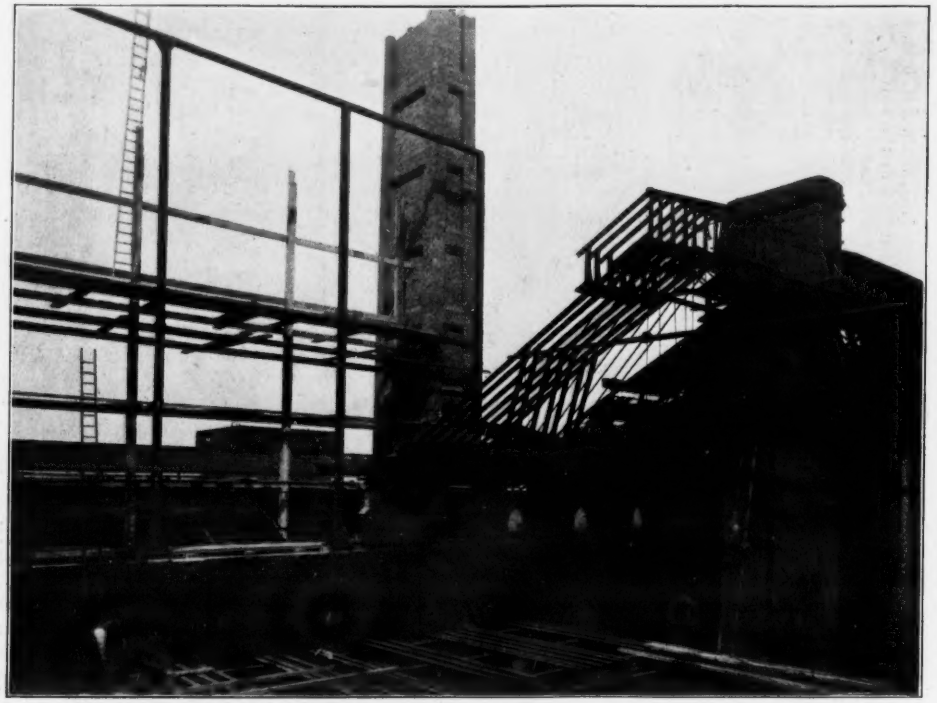
### Description of the New Settings.

Led by the allusion to the enhanced productive value of ground space when the vertical system displaces the horizontal system into a general reference to the working results, the new installation of Woodall-Duckham vertical retorts has yet to be described with rather more detail.

As already remarked, the installation consists of six settings of retorts, placed in two lines of three settings each. There are four retorts in each setting; and arrangements are made so that any pair of retorts can be worked separately. Each retort is capable of carbonizing 4 tons 10 cwt. to 5 tons of coal per 24 hours—the coal taking from six to seven hours to travel through the retorts. As already stated, the old retort-house is 56 feet wide; and so the settings were built with the clinkering stage between them to economize in width over all. Had space allowed, it would have been better for the clinkering-stage to be wider. The settings are supported on a structure of rolled steel joists, carried to the top of the settings, and connected by cross joists, which are attached to the steel framework of the house. The design is in accord with the usual practice of the Woodall-Duckham system. The retorts themselves (rectangular in section) are brick built, 4 ft. 6 in. by 9 in. at the top and 5 ft. 3 in. by 18 inches at the bottom, and 25 feet long. The walls of the retorts are grooved and tongued, and panelled at the back, so that the heat can readily pass through them to the charge in the retort. The producer and regenerator are built on the same level as the retorts and between each pair



THE STANCHIONS FOR CARRYING THE WOODALL-DUCKHAM VERTICAL RETORTS.



SHOWING THE OLD ROOF PRINCIPALS MOVED TO ONE END OF THE HOUSE WHILE THE WALLS WERE BEING RAISED.

COMMENCEMENT OF THE FIREBRICK WORK OF THE WOODALL-DUCKHAM VERTICAL RETORT-SETTINGS.

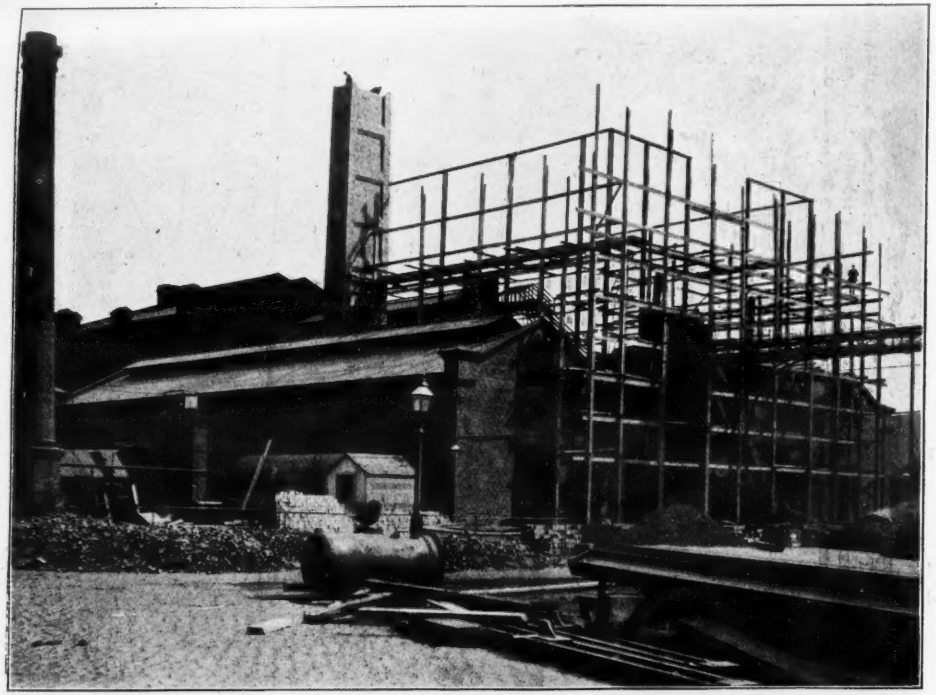
in the setting. At each side of each retort are four vertical heating flues, with the combustion chambers on the top. By looking down these flues, it is possible to see the whole of the outside of the retorts from top to bottom. There is as large a conservation of heat as possible in the setting. The incandescent coke from retorts always means the extraction of a large amount of heat from the setting. In this system, the primary air is taken around the bottom of the retorts; and thus a great deal of heat which would otherwise be lost in the coke is by this means retained. The hot primary air is then taken over water-troughs where it becomes saturated with moisture before it reaches the producer; and in this way the formation of clinker is prevented.

### The Coke-Extractor.

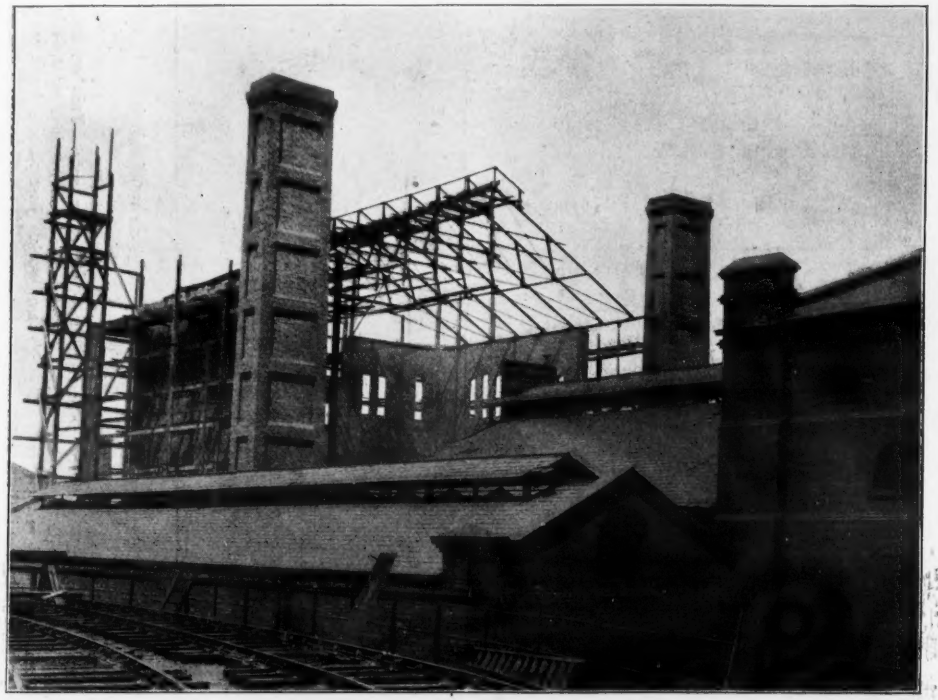
Regarding the operation of the coke-extractors. For this duty, a shaft is provided at the end of the settings, across both the benches. The shaft is driven by a 4-horse power Tangye gas-engine, with a 4-horse power electric-motor as a stand-by. [There will be further reference to the power house presently.] The speed of the shaft is one revolution a minute. On the shaft are mounted the four eccentrics, with arrangements for varying their throw; and each one is connected to a reciprocating bar, each of which operates six retorts. The retorts are in their turn driven by means of a toothless ratchet gear; and arrangements are made by which the speed of each retort can be instantly varied, to suit the temperature of the retort and other differing conditions. With regard to the extractor, it is upon the efficiency of this that the success of the plant relies; and the proof of experience is now abundant as to the device performing its functions in all essentials with the utmost certainty. The extractor roller, with its helical blades, is situated along a curved plate forming the back of the coke-receiving hopper; and this curved plate takes the weight of the charge in the retort. In addition, the action of the extractor being adjustable according to the temperature of the retorts, it is clear, from the considerable amount of coke there was an opportunity of examining before its transit from the Smethwick works, that the device does not cut or shear through the coke, and that there is no crushing weight brought to bear upon it. The receiving-hopper at the bottom, which will hold about three hours' supply, but which is cleared once every two hours, is closed by a water-sealed gas-tight door, which is operated by hand.

### Gas Connections.

The gas off-takes and foul mains are of ample design, and give absolutely no trouble. During the examination of the plant, we noticed here something out of the ordinary; and on inquiry it was found that Mr. Hughes has a device of his own for preventing trouble with stopped pipes. It is a funnel with a syphon-shaped connection to the outlet of each retort. From a water-tap above the funnel water drips, and passes into the outlet of the retort. There it evaporates; and the steam carries off any particles of light carbon, dust, or anything else that might contribute to trouble. The quantity of water is regulated by the heat; and everything is kept as clear as possible. Mr. Hughes has found this arrangement absolutely effectual for years past on his horizontal and inclined settings. For each retort a separate hydraulic main is provided, connected to a tar-tower for each bench. All the work was examined from ground-level to coal-feeding plant at the top—the means for facilitating inspection being a substantial staircase leading from the ground-floor to the clinkering-floor, and again from the clinkering-floor to the operating-floor above.



PHOTOGRAPH OF THE FRAMING FOR THE WALLS OF THE RAISED HOUSE PREVIOUS TO FILLING-IN WITH BRICKWORK.



VIEW FROM THE RAILWAY SIDING, SHOWING THE TWO NEW CHIMNEYS, AND ABOUT HALF OF THE OLD ROOF PRINCIPALS RE-ERECTED.

### Coal Feeding.

Beneath the coal storage hoppers in the roof of the house, there are auxiliary hoppers for coal charging; these having a capacity for three hours' supply. The valve controlling this is of the same rotary type as has always been used in connection with the Woodall-Duckham settings. The valve is operated by hand every two hours at Smethwick; and it only takes about ten seconds to fill the auxiliary hoppers. To these there is also fitted an indicator by means of which the attendant can see exactly how the retorts are working, and at what speed the coal is passing into them.

### Coal-Handling Plant.

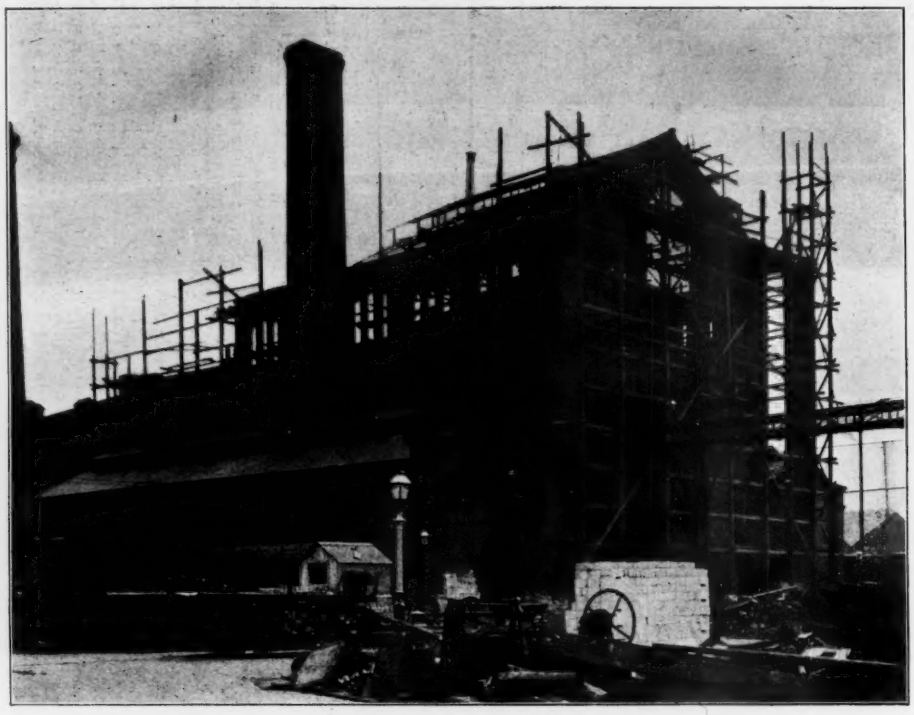
The coal for the retort-houses is delivered at the works' railway sidings. There is situated a large hopper, holding 100 tons, which is also used for supplying coal to the inclined retort-settings. From this hopper a shoot has been provided, leading to a coal-breaker (driven by a Tangye gas-engine), and thence to a gravity bucket elevator for supplying the verticals. A gravity bucket conveyor, no less than 550 feet long and operated by an 8-horse power electric motor, is employed to convey the coal to its destination above the verticals. The necessity for this length will be seen when it is mentioned that the coal-receiving hopper by the railway sidings is situated at the other end of the inclined retort-house, while the vertical settings are situated at the far side of the old horizontal retort-house. But it will also be remembered that the house will be shortly fitted complete with verticals, so that the conveyor is in position for feeding the whole of the retort-house storage hoppers for the verticals when their installation is finished. The gravity bucket conveyor from the elevator runs under the charging-floor of the inclined retort-house, then up the outside of the end wall of the heightened house in which the verticals are situated, turning along horizontally under the roof until it reaches the storage hoppers over the verticals—a band conveyor (worked by a 4-horse power electric motor) carrying the coal from the gravity-bucket conveyor to the storage hoppers on the other side of the house. These coal-hoppers have a storage capacity for about 36 hours' supply, although, of course, they can be constructed of any size to meet the desires of any engineer.

### The Coke-Feeding Plant.

There is a variation here from the, in the Woodall-Duckham design, customary provision of coke for the producers. It is usual to run the coal and coke hoppers in one continuous line above the settings—the coke-hoppers being provided with shoots for feeding the producers and the retorts after scurfing. Mr. Hughes has an objection to using the same conveyor for both coal and coke; and so he had coke-hoppers fixed outside the end of the house opposite to that where the coal is brought in. The coke-hopper is capable of holding 24 hours' supply for the producers; the hopper being fed by a gravity-bucket coke-conveyor and elevator at the gable end of the house. The conveyor is 250 feet long, is operated by a 5-horse power electric motor, and transmits coke either into the yard or into the producer coke-hoppers as required. The coke is taken to the producers, or to the retorts after scurfing, in skips, each of a capacity of 12 cwt., running on a mono-rail. It was seen during the inspection that the work by this arrangement is very expeditiously accomplished.

### In the Power-House.

The portion of the coal-store that has been walled off to form a power-house is, with its red-tiled floor and light walls, quite a good-looking and suitable place for the plant. In it are found two 17 brake horse power Tangye electric light gas-engines, working Lancashire dynamos (220 volts, 55 amperes, 280 revs.), compound



THE GABLE-END OF THE RAISED RETORT-HOUSE COMPLETED.

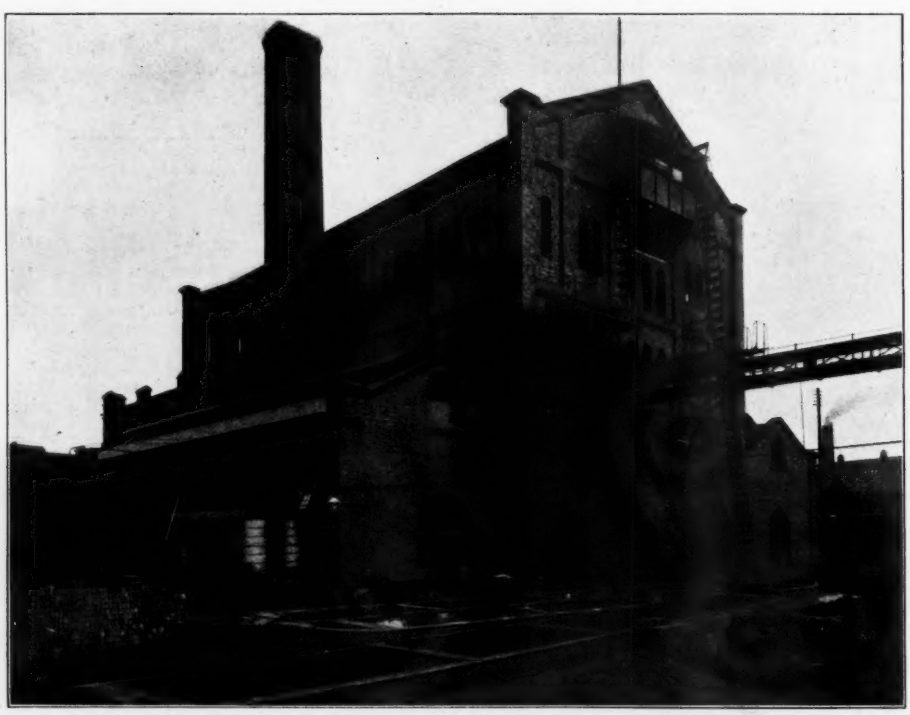
wound. These are used for developing the energy for driving the motors used for elevating the coal and coke—one being in use and the other acting as a stand-by. Here, too, is the 4-horse power Tangye engine (with a 4-horse power electric-motor as a stand-by) for driving the retort coke-extractors. Though this is a 4-horse power engine, it is being run so as to develop only about 2-horse power, and that is ample—in fact, there is then power to spare—for the work. The plant all stands on chocolate coloured glazed brick bases. Elevated in one corner of the power house is the gearing for varying the speed of the extractors. A nicely finished switchboard is another feature of the place. At night time the power-house is illuminated by two three-light inverted lamps.

### Coke-Removal Plant.

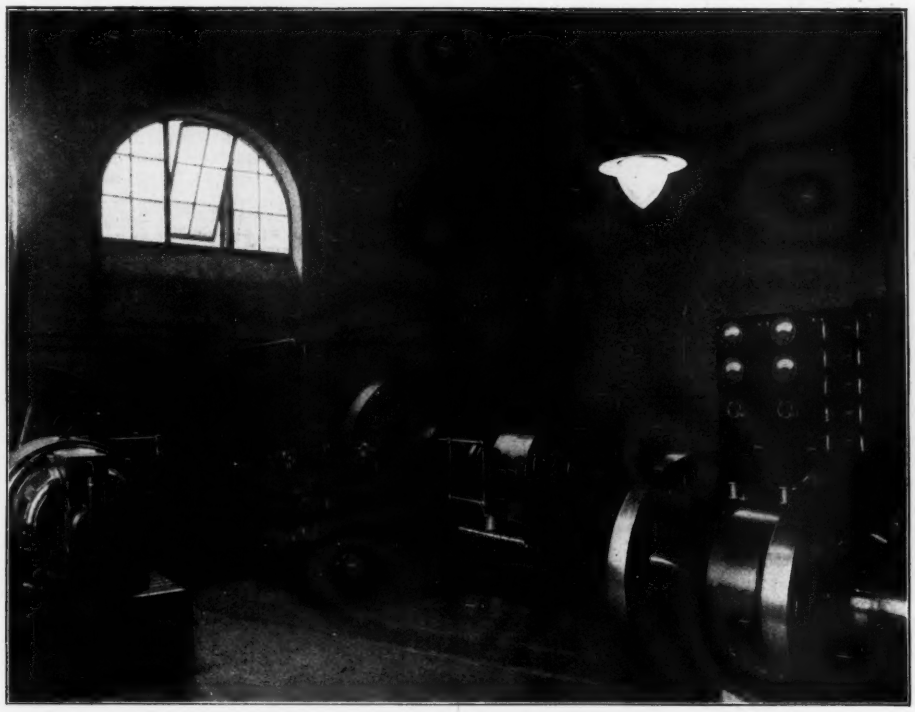
There are two lines of plate coke-conveyors under the retort coke-extractors for transporting the coke from the house to the outside plant, where it is distributed as required either to the gravity-bucket elevator for filling the producer-coke hopper, or to the plant charging barges or carts, storing the coke in the yard, or taking it to the carburetted water-gas sets. This outdoor coke plant, in the variety of the duties accomplished by it, is in itself quite an instructive piece of work. Just passing back for a moment to the plate coke conveyors in the retort-house, it was incidentally mentioned by Mr. Hughes that his experience was good with one that has been working ten years or more. One cannot deal with coke without having wear and tear; but with the little alterations made from year to year, Mr. Hughes has nothing but good to report of the plate conveyors.

### Impressions.

The plant was inspected from the coal-receiving point to the distribution of the coke. It was running silently and smoothly. There was hardly any indication that the work of carbonization



THE RETORT-HOUSE AS IT IS TO-DAY.
[In the foreground of the Picture are Barges on the Canal Basin, ready for Filling with Coke.]



THE NEW POWER HOUSE IN CONNECTION WITH THE VERTICAL RETORT PLANT.

was proceeding. When up on the charging-floor, some of the neighbouring horizontal retorts were being discharged and charged. We were unfortunate in the period of inspection, save that it gave an impressive lesson, by comparison, in favour of the verticals. The clouds of steam and dust from the horizontals rose upwards and distributed themselves along the tops of the unoffending vertical neighbours, as if in active protest against their presence. There is less waste heat too from the vertical plant than from the neighbours; and there is the freedom from pipe stoppages and from naphthalene. The number of men employed on the installation is, on the average, about fourteen per twenty-four hours, working three eight-hour shifts, including the men looking after the coal and coke feeding plant and the firing. Mr. Hughes expressed gratification with his experience; and the intention of superseding horizontals entirely by verticals is more expressive of his views than words of our own could be. We were delighted with our visit, and have to thank Mr. Hughes for the information brought together in this article, as well as for the drawings and photographic illustrations which enhance the description, and assist in making complete the story.

## ANOTHER REMEDY FOR NAPHTHALENE DEPOSITS.

THE specification has lately been published of a French patent taken out by Dr. C. Otto and Co. for removing naphthalene from gas, and consequently for preventing obstructions in the distributing plant. The following is an outline of the patentees' process.

So as to avoid deposits of naphthalene, it has been the practice, they say, to cool the gas as slowly as possible, so that the tar oils are carried along by the gas to dissolve and throw down the naphthalene in subsequent condensation. Experience has demonstrated that this treatment of gas is not sufficient to prevent obstructions; and therefore special washers are employed, with a suitable solvent, to support the action of slow condensation. The invention under notice relates to a process by which the gas is cooled as quickly as possible at a place where the temperature of the gas is about the same as the dew-point temperature of the naphthalene. Slow condensation, or even sudden cooling of the gas, must be accompanied by mechanical action between the gas and the liquid serving as the cooling medium, so as to remove the naphthalene crystals automatically and continually.

The process can be easily applied by conveying cold water or condensation water into the gas, so that the naphthalene crystals disengaged by the cooling are separated by mechanical action, and the interior walls of the chambers and pipes are at the same time well washed. In the application of the process, ejectors are preferably employed, through which cold water is run. The jet sets free the rather small naphthalene crystals carried by the liquid, from which they can be easily separated before it is sufficiently cooled to be utilized again for washing.

When, in direct recovery, it is a question of gas freed hot from tar and ammonia, the process practically begins immediately after the saturator, where the gas is at about the dew-point temperature of steam. The greater part of the naphthalene passes through the saturator, and when the gas is treated with cold water, not only the naphthalene but also a part of the water is deposited. Cooling of the wash-water in circulation is, in this case, preferably effected in a refrigerator. When this is large enough, a part of the water, corresponding to the quantity condensed, is vaporized, and the twofold result is attained of removing the naphthalene and getting rid of inconvenient waste water.

## RUST PREVENTION.

IN a previous number of the "JOURNAL," we gave an abstract translation of an article by Dr. R. Nübling, of Stuttgart, on "Rust Prevention," which appeared in the "Journal für Gasbeleuchtung." We now give some remarks by Dr. Erik Liebreich and Dr. Fritz Spitzer on the original article, and the answer that has been made to them by the author—these being translated from the same German journal.

Dr. Nübling in his article suggests the application of a solution which will fill the pores of the paint, and so prevent rusting by oxidation. Objection is raised to this on the ground that, besides external moisture, that which is given off by the linseed-oil when it dries, must be reckoned with. Moreover, this ideal solution for filling the pores has still to be discovered. It is further remarked that the potential differences mentioned by Dr. Nübling, between the pigments and the iron, have not yet actually been proved to exist, though it is strongly suspected they do. But any potential differences which do exist can be foreseen by the appearance of polarization in the pigments or the linseed oil, &c.

In answer to this, Dr. Nübling, with regard to the behaviour of the linseed oil, refers to his previous remarks. He had not advocated, he says, the use of the solution merely for filling up the pores, but had laid special emphasis on its use for old paints, and for smearing on iron, even when rusted. On these two cases, the fact that drying linseed oil gives off moisture can have no bearing at all. It can be used as a preventive against further damage, when damage has already begun. Moreover, the suggested use of a special solution is not merely a theory—Dr. Nübling having experimented on the subject for many years. He can claim, he says, a certain amount of success, though he has not yet quite found the ideal solution. A few steam tests made with such a solution showed that, whereas without the solution rust was formed in each case, with it a clean surface resulted every time.

**Midland Junior Gas Association.**—By permission of the Faculty of Science of the University, Birmingham, a lecture on "High-Pressure Gas" will be delivered by Professor F. W. Burstall, M.A., next Thursday evening, in the University Buildings, Edmund Street, Birmingham.

## THE INVENTOR OF GAS LIGHTING.

### Interesting Record of an Early Experiment.

We have received from Mr. Waynman Dixon, M.I.N.A., who is associated with Sir Raylton Dixon and Co., Limited, the well-known firm of shipbuilders and engineers at Middlesbrough, the following letter bearing upon the invention of gas lighting.

I have recently come across a printed record, dated 1810, of what appears to be the first recorded invention of the use of gas for lighting, and of experiments made in 1799 by George Dixon, Colliery Owner, of Cockfield, Co. Durham. This is more especially interesting to me; this George Dixon having been my grandfather. It occurs to me, however, that it may be of interest to the large circle of engineers, managers, &c., connected with this enormous industry throughout the world. And how can it better be made public than through the columns of your leading paper? I therefore enclose a copy, typed from the book itself, of this reference, for which I trust you may be able to find room.

Accompanying the letter was the following extract [pp. 290 to 292] from a book published in 1810 by Richard Phillips, Bridge Street, London, and others, the title page of which is—

GENERAL VIEW
OF THE
AGRICULTURE
OF THE
COUNTY OF DURHAM, WITH OBSERVATION
ON
THE MEANS OF ITS IMPROVEMENT DRAWN FOR THE CONSIDERATION OF THE BOARD OF AGRICULTURE AND INTERNAL IMPROVEMENT.

By
JOHN BAILY.
1810.
(Price 10/6 in boards.)

COAL TAR.

About seven years since, some works were erected at Heworth Shore-upon-Tyne for making coal tar; but the first work of this kind that was ever established in the kingdom for extracting tar from coals was at Cockfield, by the original inventor, the late very ingenious Mr. George Dixon, in 1779,* who continued making it until 1783, when he dropped the business on account of the heavy expense of land carriage to Sunderland, where the tar and pitch were principally used for ship-building.

This species of tar and pitch had been found much more durable for ship bottoms than that obtained from vegetable substances, and also resists the ravages of the worm, so destructive to ship bottoms in the Southern Oceans. The quantity made per week was about six barrels, besides a considerable portion of coal oil, for which there was at the time scarcely any demand.

He had discovered the process for extracting tar from coal upwards of twenty years before he began to manufacture it for sale, as I remember being much amused, when a little boy, by his filling an old tea-kettle half full of coals, setting it on the fire, and luting a tobacco-pipe with clay to the spout, and to this several others round the end and side of a room. After a certain time, he put the flame of a candle to the end of the farthest pipe, and immediately a bright flame issued from it, where nothing was perceptible before. He then made a small hole with a pin through the clay that luted the pipe heads and shanks together, and applying the flame of a candle to each, there were as many flames as pipe heads. He had only made the discovery a little before, and this was probably the third or fourth exhibition of illuminating rooms by gaslight.

This mode of lighting rooms was for a long time a favourite project with him, and he had thoughts of lighting his collieries with them, but was cured of it by the following experiment, at which I was present: Wanting to know the quantity of tar produced by a ton of coals, he erected a furnace with a large cast-metal boiler, in which the coals were put. To this were fixed two large cast-metal pumps. One of them passed through water, in order to condense the oil and tar; and the end of this was filled by a wooden plug with a small hole to let out the tar, &c. Towards the conclusion of the experiment, he placed the flame of a candle to this hole, and the inflammable gas immediately burnt with a large bright flame. To extinguish this, he struck it with his hat; the flame was drawn inwards, the gas in the inside of the apparatus took fire as quickly as gunpowder, and exploded with a report like a cannon, driving out the wooden plug to a great distance, and exhibiting a cylindrical body of fire several yards in length. The heavy cast-metal pumps were removed from their places. From this time he considered his project of lighting collieries and rooms with gas lights as very dangerous; and I record the experiment with a view that it may probably be a useful hint to those who are at present engaged in similar projects of lighting manufactories and great towns with a material so subject to explosion.

* In 1781, Lord Dundonald got a patent for making coal tar, and from this circumstance has been generally thought the original inventor, though tar from Mr. Dixon's manufactory had been in constant use for at least two years before for shipbuilding, &c.

The next meeting of the Yorkshire Junior Gas Association will be held at the Leeds Institute of Science, next Saturday, when a paper will be read by Mr. C. V. Townsend, of Wakefield, entitled "Some Notes on Purification by Oxide."

## DISTRIBUTION OF GAS.*

This well-known work has, in its third edition, been subjected to a good deal of revision, without any corresponding increase in its bulk. Some of the subject-matter has been omitted; but there is no doubt that the alterations and additions have increased its value as "a serviceable text-book for the student, and an up-to-date handbook for the gas manager." It is only three years since the second edition was published, but that is an appreciable period in the development of so live a matter as the distribution of gas. The use of high-pressure gas, and recent improvements in methods of illumination, heating, and combustion have combined to render desirable a new treatment of this subject. This Mr. Hole has done in a way both adequate and praiseworthy.

The importance of the distribution of gas is obviously increasing year by year; and it is in the direction of the adoption of the best methods that so many gas undertakings must look for increase in consumption and reduction in the price of gas. A thorough understanding of the business of distributory methods, such as are fully explained in the work under review, and energy in putting them into practice, together with the powerful backing-up of the British Commercial Gas Association, is bound to largely increase the prosperity of any gas undertaking. For this reason, the time chosen for the issue of a new edition is appropriate.

The book can rightly lay claim to being complete. For some reasons it is, therefore, unfortunate that, in order to keep the volume within reasonable bounds, it is necessary to omit much useful matter that was included in the earlier editions. Even now Mr. Hole's book contains nearly 850 pages, with over 600 illustrations. The writer considers that a number of the figures—such as, for instance, many of those illustrating the chapter on internal fitting (Chapter XX.)—might well be omitted, without in any way detracting from the value of the work. Such a course would make room for some of the deleted portions. The only other alternative would be to publish the next edition in two volumes. It is noticed that, in order to retain the volume in its original size, the text has encroached upon the margin to the extent of $\frac{1}{2}$ inch in width and $\frac{1}{8}$ inch in depth. It must not be thought that the illustrations generally are being subjected to criticism, as, on the contrary, they are a strong feature of the book. Reference is only intended to those illustrations which are a matter of common knowledge to 99 per cent. of the readers of the work. This criticism would not apply were the book written for the gas consumer or householder.

The author's practice of quoting chapter and verse for each appliance mentioned is desirable, in that though advantageous to the manufacturer, it is of equal benefit to the reader. The publication of the third edition has given Mr. Hole the opportunity of including many of the recent additions to the market. New governors, meters, methods of jointing, instruments, machines, and tools find their place in the new edition; in some cases being supplementary, and in others superseding earlier devices.

High-pressure distribution bids fair to revolutionize old methods of conveying gas; and Mr. Hole has taken advantage of this tendency to introduce into his work the up-to-date methods—such as in the jointing of gas-mains by welding, of burning gas under high-pressure, and of the calculations involved in ascertaining the size of pipes required for a given quantity of gas. A single chapter of 62 pages on high-pressure distribution in the second edition has made way for five separate chapters containing in all ninety-three of the larger size pages in the third edition. This subject has been divided into the following sub-headings: General Considerations, Transmission, Compressors, Distributing Apparatus, and Internal Lighting and Heating. These chapters form a feature of the new publication. As would be expected of the author, the subject is treated in a particularly comprehensive and able manner. It is noticed, however, that much too little attention is paid to the important subject of high-pressure heating. This is unfortunate, in view of the undoubted suitability of high-pressure gas for such work. One would also expect to see some reference to the wonderful system of surface combustion, invented by Professor Bone and Mr. M'Court.

The chapters on "Internal Lighting" and "Gas Fires and Cookers" have been satisfactorily revised; and it is noticed, with pleasure, that Mr. Hole has improved his chapter on "Gas as an Aid to Ventilation," in which he discusses the respective effects of the carbonic acid produced by the combustion of gas and by human respiration, showing plainly the fundamental difference between the two forms of impurity. We suggest that the subject might be still further enlarged.

* The "Distribution of Gas." By Walter Hole, of Leeds. Third Edition. London: John Allan and Co.; 1912.

**Arbitration Clause in Contracts.**—We have received from Messrs. Constable and Co., Limited, a pamphlet by Mr. E. J. Rimmer, Assoc.M.Inst.C.E., on "The Arbitration Clause in Engineering and Building Contracts," with suggested modifications in view of recent decisions. The author, who is a barrister, has collected a number of cases, and he trusts the consideration of them and the suggestions he has made will do something to lead to the adoption of a form of contract between building owners and contractors under which the former can be free from the fear of expensive litigation, and the latter from the fear of unfair arbitration. The price of the book is 2s. net.

## LONDON AND SOUTHERN JUNIOR ASSOCIATION.

### Visit to East Greenwich.

There was a large turn-out of members of the London and Southern District Junior Gas Association on Saturday afternoon, when a visit was paid to the East Greenwich works of the South Metropolitan Gas Company. This was not in any way surprising, because, the Association having been to the works before, many of the members knew from personal experience, and others doubtless had heard, how much of interest there is to be seen. The time available was, it is true, something like two hours, instead of the two days, or perhaps two weeks, which could profitably be spent on a careful inspection; but the most was made of the afternoon, under the guidance of Mr. F. J. Bywater (the Engineer of the works), and members of his staff, among whom may be mentioned Messrs. R. H. Collins, F. Shadbolt, G. Cox, F. A. Frost, and Lamprey.

The company having been formed into parties, a visit was first paid to the sulphuric acid and sulphate of ammonia works. For the purpose of making sulphuric acid, and also as an outlet for the Company's spent oxide, a plant (consisting of four units) capable of turning out 400 tons per week has been erected. The works also contain a plant for concentrating, by the Kessler process, the ordinary acid up to 80 or 96 per cent. acid. Some time was spent over the sulphate of ammonia plant, which consists of three units, capable of dealing with 65,000 gallons of liquor per day. The stills, which were designed by Mr. Charles Carpenter (the Chairman of the Company), are of a powerful type, and are found to be very efficient in working.

After seeing the plant for dealing with the breeze and clinker, the coaling arrangements were explained to the visitors. The coal comes to the works from the North of England in steamers, which are berthed alongside the jetty at high tide. From the ship's hold the coal is lifted by four hydraulic cranes, with self-acting grabs, which then discharge it into storage hoppers. At the time of the visit, there was a steamer alongside, with a cargo of 3500 tons of Durham coal. From the storage hoppers, the coal is conveyed by locomotives to the required place—sets of rails running into each retort-house. There is accommodation for the storage in the different retort-houses of about 35,000 tons of coal under cover, and anything up to 300,000 tons outside.

The present make of gas at the works is 23 million cubic feet per day. There are five retort-houses; four being capable of manufacturing 6 million cubic feet per day each, while in the fifth one section (equal to an output of 2 million cubic feet) has been got to work this winter. The houses are parallel with the river, and at right angles to the elevated railway which runs from the jetty. This affords convenient and economical means for supplying each section with coal, and for the removal of the coke and breeze. The retort-houses contain forty-five settings, in three benches of fifteen, with ten retorts in a setting; and the retorts are of ⌂ shape and of elliptical section. All the stoking machinery is operated by hydraulic pressure—Arrol-Foulis chargers and Hunter-Barnett dischargers—the time for charging a retort being 40 seconds, and for discharging 20 seconds. Twelve-hour charges are worked.

As to the subsequent processes which the gas undergoes, it may be remarked that the condensation is effected by a combination of air and water cooled condensers. There are six sets of compound, horizontal, and steam-jacketed engines of the Farey type, each working two exhausters; and in this portion of the plant there is a margin of some 50 per cent. in excess of winter requirements. For washing the gas, there are Livesey washers, worked three in a set, and tower scrubbers, filled with wooden boards, worked in sets of two or three. To the outlet of each set of purifiers there is connected a Livesey washer for the extraction of naphthalene. In the five sets of purifiers (which are 60 feet by 30 feet), lime is at the present time being used as the purifying agent, with oxide catch-boxes. Next year, however, Mr. Carpenter's sulphur purification system will be put in operation, and then the use of lime will be discontinued.

Most of the gas manufactured at East Greenwich (only about one-quarter of the output goes to the district surrounding the works) is pumped away for distribution in the Old Kent Road and Vauxhall areas; and for this purpose two fans are used, each capable of dealing with 1½ million cubic feet of gas per hour. In connection with this plant, the gas-engines proved interesting to the members. There are two of 90 H.P. and two of 45 H.P.; and the difference between the modern vertical type and the older horizontal ones is very marked—the new 90 H.P. engines taking up about one-fifth of the floor space, and being half the size, of the 45 H.P. horizontal ones. For storage, there are two holders. One of these is of 8 million cubic feet capacity; and the other is the well-known 12 million cubic feet holder, with six lifts, two of which run above the guide-framing.

The time at disposal for the inspection of the works having expired, the party were invited into the men's Institute, which they found to be in reality a first-rate club-house, fitted up in every way for the enjoyment of the members. The building is a new and substantial one; and the main hall is fitted with a complete stage (on which is a grand piano), while there is an excellent floor for dancing. Elsewhere there are billiard tables, rooms for cards and other games, and a full-length miniature rifle-range, which is a great attraction. There is excellent lavatory accommodation, including shower baths; and in front of the building a nice lawn has been laid down. The men pay a weekly subscription, though membership is quite voluntary; and it is gratifying to learn that the Institute is in a thriving condition—there being at present about 860 members. In the main hall, the visitors sat down to tea; and, before separating, suitable expression was given to their gratitude to those to whom they owed so pleasant and instructive an afternoon.

The President (Mr. D. J. Winslow) remarked that the visit that afternoon exactly coincided with the inspection of the Old Kent Road works of the same Company last year. They were greatly indebted to the South Metropolitan Gas Company for the good send-off they gave the Association in both years. He hoped it would become an institution, and that this time next year they might be at another of the Company's works. In connection with the works of the South Metropolitan Company, one could not help thinking of the Livesey washer. It was astonishing to find that the Livesey washer as applied to-day was practically in exactly the same form as originally. The fact that no more structural alterations had been made in it, showed what an excellent machine it was as first designed. At Lea Bridge, they had just put down a Livesey washer to deal with 2 million cubic feet of gas per day; and he believed it was an exact model of the original washer invented years ago by Sir George Livesey.

A hearty vote of thanks to the Company and to Mr. Bywater and his assistants, for the hearty welcome extended to the Association, was proposed by Mr. J. G. Clark, who remarked that the visit had been a real intellectual treat. It was not often they saw so many processes carried on at one works. Mr. S. B. Chandler seconded, and agreed that they had had a most instructive visit. Mr. Bywater had, he said, had much experience with refractory materials; but he hoped the "material" he had had to deal with that afternoon he had not found in any degree "refractory." Mr. W. J. Liberty supported the proposition, and referred to the many changes that had taken place since the Association were at the works five-and-a-half years ago.

The vote having been carried with applause, Mr. Bywater, in acknowledgment, said, on behalf of the Company, that they were very glad to have the members of the Association at the works, and trusted that they had seen something of interest. The Company were always glad to see the junior engineers at their works, because there was a tremendous amount of enthusiasm actuating their visits. It had given him personally—and he was sure he could say the same of his assistants—great satisfaction to show the members over the works. He had himself experienced much benefit from being a member of the Midland Junior Association; and he thought visits of this kind were an important feature of the programmes of such bodies. The opportunity afforded for interchange of ideas was very valuable. It was a credit to the Association to see ninety or so members devoting the Saturday afternoon to furthering their professional work. As to his staff, who were friends of the members and friends of his, it gave him great pleasure to state that they were most loyal and painstaking in their work on behalf of the Company. It was only with their willing and capable assistance that one was able to make anything like a show at such a works as that. He had been asked by Mr. Doig Gibb to say how sorry he was not to be able to be present to renew his acquaintance with the members, and to assure them that, so far as the Company were concerned, they were always glad to see the Association, and hoped they would pay them another visit at some future time.

## SOME PRACTICAL OBSERVATIONS.

By John Frazer, of Provan.

**[A Paper submitted to the Scottish Junior Gas Association, Western District, last Saturday.]**

To read a paper before this Association, and have one's opinion on any subject discussed by his associates, should be the aim of every member, as by doing so he will not only add to the store of his own knowledge, but also to that of others. It has been handed down to us by some very able members of the profession that money can be made or lost in the retort-house. I am a firm believer that this is the case, and will endeavour to describe to you some methods by which the best results may be obtained.

To begin, one must have a proper system which should not be departed from without due consideration—as haphazard methods always end in disaster. Having established a system, attention to the most minute detail becomes an easy matter, and the proper supervision of the work can be carried out without causing annoyance and worry to those responsible.

### System.

A few years ago, it dawned on quite a number of gas managers that a heavier charge would give better results—a fact which can be borne out by figures. In 1909, we added 48 minutes to our period of carbonization at Provan, with good results—so good that we have never altered. I mention this for the purpose of drawing your attention to an alteration which this change caused to be made on the coal-feed of our stoking-machines, which are of the well-known Arrol-Foulis pattern. Formerly the coal-drum, rotating through seven teeth of the ratchet, dropped a fixed quantity of coal at six intervals, which was found unsuitable for the

new system. We consequently set about devising means whereby this evil could be remedied. The outcome of the change is a perfect arrangement, whereby the feed can be altered at will through a range from six to nine teeth on the ratchet, dropping heavily at the back end of the retort, and tapering off towards the front, instead of dropping an extra shot or missing one as formerly.

Previous to the alteration referred to, the stopper for regulating the coal-feed was actuated by a screwed steel rod carried on a bridge underneath the cylinder which held the nut in position; the plain part of the rod passing up through a packed stuffing-box, and the screwed end terminating with a hand-wheel, alongside of which was placed a scale denoting the stroke of the ram in inches. The great difficulty with this stopper was that, like most screws coming in contact with water (which it did when any of the glands leaked), it became rusted up and remained a fixture; it being almost impossible to keep the screws free and in good working order, as once they were set they did not require to be moved very often.

The alteration made was the taking away of the screwed rod, and removing the nut from the bridge, substituting a bush for it, boring and tapping the end of the ram, and inserting a turned and screwed rod, the plain part passing down through the bottom of the cylinder, and thence through the packed stuffing-box and bridge, which now forms a guide—the end of the rod coming to rest on the movable stopper, which is stepped three times, each step having a rise of $\frac{5}{8}$ of an inch. This being equal to one tooth of the ratchet, gives the range of nine teeth. The movable stopper is actuated by rack-and-pinion; the rack being bolted to the stopper, and the pinion keyed on to an upright shaft which has a hand wheel at either end. The spokes of this wheel are four, and serve as a guide to the machineman, as each quarter turn represents one step of the stopper or one tooth of the ratchet. To operate the stopper, the machineman has only to turn the hand-wheel; and he can do this without leaving the machine platform.

This simple device, in my opinion, is the means of saving tons of coal weekly; for had the extra coal required been charged in two additional shots, it would not have been carbonized in the specified time. Invariably, where one or more double shots were required, they had to be rammed each into a space allotted for one shot only. The result of this ramming was that the centre of the charge, at that particular part of the retort, was never thoroughly carbonized. This appears a trifling item, since it was only a little "smoky." But consider the cause of this smoke, and allow the very meagre amount of 1 lb. of coal lost per retort. Multiply this by the number of retorts in action, which at the time of writing is 1788, and then by 5, being the number of charges in 24 hours. This gives a loss daily of 4 tons of coal, which, at the rate of 11,000 cubic feet per ton carbonized, should convince everyone of the desirability of taking all out of the coal that is in it.

### Coal.

The question as to the class and suitability of coal for gas-making purposes is only to be arrived at after a series of tests, laboratory and practical; the selection being based on the results obtained. It is for us in the carbonizing department to have the coal examined in a thorough manner for dirt and stones, fire-clay, and other foreign matter, and report thereon. For the proper performance of this important duty, two men are employed occasionally to pick and hand-riddle a waggon of each of the coals being supplied. All the loose pieces of foreign matter contained in the waggon of coal are passed to one side and carefully weighed; the lumps of coal being put into an empty waggon placed end-on to the one containing the coal under examination. The whole of the remaining coal is passed over a 1-inch mesh riddle; and the material passing through is considered unfit for our purpose, unless it be a coking coal. The colliery officials are notified of what is being done; and one of their representatives is asked to call and see the material. We are then in a position to show him the true nature of his coal. This course may appear a little one-sided; but as the waggon to be examined is taken at random (not selected), I consider it is perfectly fair and just to both parties. Further, if there is any doubt about a certain coal, three waggons are taken and treated in the foregoing manner, and the average accepted as representative. Having had a visit from the colliery official, we are assured that greater care will be taken, and so forth, or that he is convinced that the complaint was well founded. I am pleased to say, on their behalf, that in most cases their promises are kept. The picking of coal would seem to be an expensive item; but this is not the case, considering that at Provan close upon 1000 tons are carbonized daily, and that in some of the waggons picked the percentage by weight of stones and dirt has been high enough to more than justify the outlay.

### Heats.

The heating of retort-settings, and maintaining the heat with the greatest degree of regularity, is the aim of every gas manager. Unfortunately for the profession, the manager does not always get the results he expects from this very particular unit of his plant. The heating of our retort-benches at Provan is, as most of you are aware, performed by outside producers. This system gives splendid results; our heats seldom varying, and being maintained at an average of about 2200° Fahr.

I will give a description of the producer, and explain the practice applied in "lighting-up" until the retorts are ready for coal. Before proceeding to "light-up" the producers, it is necessary to see that all the outlets from the main gas-flue and inlets to the regenerators are properly plugged, to ensure that no gas passes on to the settings unlit. Having attended to these details, steam is admitted to the main gas-flue from the dampers forward; a temporary 4-inch pipe on either side and at the dead-end of the flues being led up through the roof for the purpose of securing an outlet for the air contained in the flues, which is driven forward and expelled by the steam when admitted. The steam is in turn expelled by the gas when the former is shut off, and the producer dampers are opened, admitting gas to the flues at 3-10ths of an inch pressure.

A layer of ashes is placed in the bottom of the producers, which we term the "ashpit"—the depth of the ashes being equal to the top of the grate. Then there is a layer of cold coke about 18 inches deep. The producer is kindled by putting in about 9 inches of hot coke, and filling up with cold coke. Immediately after this has been done, steam is turned on at the blower, at which point the steam draws in the requisite amount of primary air. The air and steam combine, and pass up through the coke, forming carbon dioxide, which is blown away through the bell-holes to the atmosphere. Everything being now in order, the dampers are opened, and the bell-holes closed gradually; at the same time the steam in the flues is reduced until it is finally overcome by the gas pressure from the producers. The steam is now shut off, and the flues are under gas pressure; but, being of an inferior quality, it is blown off to the atmosphere, through the clinkering-holes and the temporary 4-inch pipe before mentioned, until it is ascertained by test that the gas contains not more than 6 per cent. of carbon dioxide, oxygen, and 24 per cent. of carbon monoxide.

Being assured that the gas is of good quality, we proceed to admit it to the ovens. This is done by removing the plug from the inlet, which, by the way, is a 4½-inch brick wall. Following this, the cast-iron plug is removed from the outlet. But before doing so, it is imperative that a jet of coal gas should be burning in the inlet, to make certain that the gas passing on is fired immediately after it passes the flue dampers, which are now opened ¼ inch, allowing the gas to pass into the inlet to the oven. At this stage, the front of the inlet is open to the atmosphere, and the settings and regenerators are under chimney draught. In the course of eight hours, a slight heating of the brickwork is perceptible; and in sixteen hours the heat can be noticed in the third course of regenerators. This gradual process of heating is carried on for three or four days, until a dull red heat is observed in the settings. The fronts of the inlets are then built-up, and the gas is allowed to fire in the combustion chamber, which at once quickens the heating so rapidly that, if necessary, we could have the retorts ready for coal in sixteen hours from the time the inlets were built-up.

The bench is now under fire, and in good going order without any fuss or confusion; for past experience has taught us that in setting gas-dampers and secondary air inlets there is just a "happy medium" which can only be gained by patient observations, as time is required to tell whether the oven has too much or too little gas or secondary air as the case may be. Not so very long ago, one would have been laughed at had he talked of giving an oven ⅛ inch more secondary air or ¼ inch more chimney damper; but I assure you that I have found an alteration of ⅛ inch, small as it may appear, to have been exactly what was required to make perfect heating possible. I condemn the practice of haste when judging the heat of an oven, such as making an alteration in the afternoon and expecting results the next morning. You cannot get results on short notice; it takes time and patience. There may perhaps be some other cause which has been overlooked. I have noticed that a sudden rise or fall of the barometric pressure, if maintained for any length of time, has a great effect on the heats—especially with our ovens, which, being under pressure, are more susceptible to increased or decreased chimney draught.

With regard to our producer gas, and how it is obtained with the smallest possible quantity of fuel, this is another instance of patience, time, and observation, as it took months to ascertain what the proper size of the steam-nozzle should be, and what was the size of the primary air opening best suited to the various mixtures of coal carbonized. I believe we have now reached the acme of perfection, as the ashes taken from our wet ashpits contain a very low percentage of coke.

How the producer gas is steadily maintained at 3-10ths pressure I will explain in as few words as possible. For some time after we started the plant, we had a gas-governor controlling the steam-throttle; and, try as we might, we could not get satisfaction, as the pressure was fluctuating through 3-10ths—sometimes one thing, sometimes another, and being anything but steady. This, of course, was due to the rise and fall of the steam pressure at the boilers. To overcome this difficulty, we had reducing valves put in; reducing the pressure from 150 lbs. per square inch at the boilers to 100 lbs. at the producers. This had the desired effect. Now we have a steady pressure throughout the whole period when the six producers are at work; dropping 1-10th when one of the number is off for cleaning.

### Hydraulic Main.

I am inclined to think that sufficient attention is not always paid to the hydraulic mains, as, speaking from experience, I know that the top of the bench is not the most desirable place in gas-works. Consequently, the mains receive scant attention, even from those whose duty it is to see that everything is in order. The mains at Provan are divided by a plate, placed centrally in the main,

having an opening at the top to allow the gas to pass through to either end. In the centre of each section a weir-valve is fixed. It is to the care and use of this valve that your attention is desired. In course of conversations, I have heard persons condemn the valve as useless; it having failed to perform the function claimed for it, and becoming clogged up with tar which would not run off. This experience has been mine, for I have found that when left alone for a short period the valves certainly do clog. But why should they be left alone? By using them judiciously, one is enabled to keep the seal in the main in a perfectly liquid state, instead of having our "bogey"—pitched mains. At Provan, the practice is to scour the mains twice weekly; and it is found that we are well repaid for our labour. You are aware that by keeping a light seal the retort pressure is reduced, with a subsequent reduction of the formation of retort carbon; thus saving fuel, and securing every cubic foot of gas produced. There are fewer leaky retorts; and this, with the reduction in the number of stopped pipes, is a good case in favour of proper attention being given to the weir-valve.

I should, however, like to point out a little failing of the weir-valve and how it may be easily put right. On the top of the valve proper there is always a tendency for deposits to collect; and these I have seen to a depth of $\frac{3}{8}$ inch. This may be simply removed by drilling a hole on the side of the valve-chest, and inserting a piece of wire rod bent at right angles, and drawing it across the upper edge of the valve a few times. The deposit will then be removed. Care should be taken to plug the hole.

### Exhauster Engines.

Every member who has anything to do with this most important part of the plant will have realized the great difficulty experienced in keeping a steady vacuum, though regulated by a governor, without using the bye-pass of the compensator, which is at all times to be avoided, as they come under the heading of "misspent energy" by using unnecessary steam, *plus* the wear and tear of the engine and exhauster. To avoid this waste of energy, a reducing valve is placed on the steam-pipe supplying the engine, reducing the pressure by (say) 15 lbs. per square inch. The engine governor is at once relieved from the difficult action of regulating steam to the engine at varying pressures, as the difference between the boiler pressure and that of the engine, being 15 lbs. per square inch, allows the boiler pressure to fluctuate to the extent of 15 lbs. without being felt in the engine-room. This permits greater liberty of action to the governor; as it has then only to cope with an increase or decrease in the make—the steam being a constant.

Before leaving the exhauster-house, there is another matter which I should like to point out—one which I am certain is not in general practice, but which I think ought to be—and that is in connection with the vacuum shown in the exhauster-house. The common practice is to show the vacuum on the inlet side of the exhauster, which may amount to inches, while in the retort-house the actual vacuum is (say) 12-10ths. This, in my opinion, is bad practice, and should be avoided. It can easily be done by running a malleable iron pipe from the inlet to the condensers direct to the exhauster-house, and terminating it with a King's gauge showing at a glance the actual vacuum in the retort-house.

### Naphthalene.

I have been asked why we are so free from the naphthalene pest when we have very high heats. I will try to explain the precautions we have adopted to prevent the naphthalene leaving the works. The scrubbers are thoroughly cleaned and examined annually, making sure that there is no deposit left between the openings of the grids. We work the scrubbers in series, so long as our daily make permits; pumping the light oils, which overflow from the clean scrubber, back into the first or dirty scrubber. When this can no longer be carried out, owing to the scrubbers having to go on singly, our practice is to run into the scrubber weekly about 16 gallons of a solvent. This has had the effect of keeping us clear since our first and only experience of naphthalene trouble. It occurred at the inlet to one of our holders; and you may be assured that every care will be taken to prevent a repetition of the trouble. We treat our holder inlets and outlets in a similar manner as the scrubbers.

### Arrangements for the Session.

The programme for the session shows that the following further arrangements have been made: Nov. 23—Visit to the Auchengeich Coke-Oven Works (Messrs. J. Nimmo and Co., Limited). Nov. 30—Paper on "High-Pressure Lighting," by Mr. Walter Grafton, of Glasgow. Dec. 14—Annual social. Jan. 25, 1913—Visit to the Pumpherston Oil-Works. Feb. 8—Paper on "Gas for Heat, Power, and Light," by Mr. Thos. Carmichael, of Dawsholm. Feb. 22—Inspection of the vertical retorts at the Dawsholm Gas-Works. March 8—Paper on "The Vertical Retort of the Shale-Oil Industry," by Mr. G. F. M'Killop, of Broxburn. March 22—Joint visit with the Eastern District Division. April 12—Annual general meeting; lecture by Mr. J. W. Napier, of Alloa.

**Development of the High-Pressure Lamp.**—By inadvertence, in the paragraph on p. 419 of last week's issue, the name of Mr. James Keith was given as the originator of the great advance referred to in inverted high-pressure gas lighting. The credit, of course, should have been given to Mr. George Keith. Mr. James Keith has added to the wealth of the world's utilities by his important inventions; but this particular one was due to his son.

# THE RADIATION FROM FLAMES AND THE WELSBACH MANTLE.

By E. J. Evans, B.Sc. (Manchester).

**[A Lecture given at the Manchester University, Saturday, Oct. 12, before the Manchester and District Junior Gas Association.]**

As an introduction, it will be necessary to discuss some of the principles of radiation, especially that type of radiation known as temperature radiation. According to the accepted theory, light and radiant heat consist of waves which are propagated in free space with a velocity of 30,000 kilometres per second. These waves are similar in nature to the waves propagated on the surface of water; and the distance between successive crests is called the wave-length. If the radiation from a hot body like the positive pole of the electric arc is passed through a glass prism, and then allowed to fall on a screen, a coloured band of light is obtained. This coloured band or spectrum, which is red at one end, passes through orange, yellow, green, and blue to violet at the other end. It can also be shown that there are other radiations invisible to the eye outside the limits of this coloured band.

The radiation beyond the violet, which is called ultra-violet, can be detected by its action on a photographic plate; and the radiation beyond the red, called the infra-red, can be detected by the heat it produces when allowed to fall on a delicate electrical thermometer. On the wave theory, these radiations are distinguished by their different wave-lengths. The radiation which produces the sensation of red light has a greater wave-length than that which produces the sensation of violet light. The wave-lengths in different parts of the spectrum are shown in the following table.

| | Millimetres. |
|---|---|
| Schumann waves | ·0001 |
| Ultra-violet | ·0002 |
| Violet | ·0004 |
| Green | ·0005 |
| Extreme red | ·00075 |
| Infra-red | ·001 |
| Heat rays from syhrte | ·06 |

It is convenient to express wave-length in terms of another unit, and the one which will be employed throughout this lecture is called the micron. This unit, which is usually denoted by $\mu$, is 0·001 mm.; and the wave length of any particular radiation—say, green—can be written as ·5 $\mu$. The visible spectrum is usually considered to extend from ·41 to ·76 $\mu$.

The radiation emitted by luminous bodies may be conveniently divided into two classes—(*a*) Temperature radiation, and (*b*) luminescent radiation. In the former class are placed all bodies which are luminous in virtue of their high temperature, and in the latter class bodies which are luminous at comparatively low temperatures. The radiation emitted by the carbon filament lamp is an example of the first type, and the luminosity induced in a rarefied gas by electrical discharges is an example of the second type. In the second type of radiation, the luminosity is mainly due to causes other than temperature.

### Temperature Radiation Laws.

Kirchoff, in discussing temperature radiation, introduced the idea of a perfectly black body. Such a body is defined as one which absorbs all the radiation incident upon it. It can be shown that the radiation inside an enclosure kept at a constant temperature has all the properties of black body radiation. The radiation emitted through a small hole in such an enclosure approximates very closely to that of a black body.

It is now necessary to define the two terms emissive power and absorptive power, which occur frequently in the discussion of temperature radiation. The emissive power of a body is the energy radiated per second from one square centimetre of its surface; and the absorptive power is the fraction of the energy incident upon its surface, which is absorbed. If the emissive power of a body for any wave-length $\lambda$ is denoted by $E\lambda$, and its absorptive power for the same wave-length and temperature $A\lambda$, Kirchoff showed that $\frac{E\lambda}{A\lambda} = e\lambda$, where $e\lambda$ is the emissive power of a black body at the same temperature. This relation, which is known as Kirchoff's law, only holds for radiation which is due to temperature.

### Deductions from Kirchoff's Law.

(1) If $A\lambda = 0$, $E\lambda = 0$ since $E\lambda = A\lambda\, e\lambda$. This means that if a body does not absorb a radiation of a given wave-length, it does not emit that radiation. Sodium phosphate, which absorbs very little within the limits of the visible spectrum, is found to emit scarcely any light when heated to a high temperature.

(2) Since $A\lambda$ can never be greater than 1, the emissive power ($E\lambda$) of any body can never be greater than the emissive power of a black body at the same temperature.

### General Remarks on Temperature Radiation.

Solids and liquids can be made luminous by heating to temperatures above 500° C. Gases and vapours, with a few exceptions, cannot be made luminous by the application of the highest temperatures at our command. Iodine is one of the exceptions; and the orange yellow light emitted by it on heating to 600° C. has been carefully studied. The emitted light gives a discontinuous spectrum, consisting of a large number of fine lines, which

coincide in position with the dark absorption lines obtained by passing white light through the vapour. In connection with temperature radiation from gases, the case of carbon dioxide is of great interest. This gas has an absorption band in the infra-red at about 5$\mu$; and when a layer of the gas 7 centimetres thick is heated to any temperature, it emits a radiation of that particular wave-length (5$\mu$), which is of the same intensity as the corresponding wave-length in the spectrum of a black body at the same temperature.

### Radiation from a Black Body.

Kirchoff's law applies to any body emitting radiation due to temperature; but the laws which will now be considered apply to black body radiation.

(*a*) *Stefan's Law.*—The total energy radiated by a black body is proportional to the fourth power of its absolute temperature. If E denotes the total energy in calories radiated per second per square centimetre of surface, and T the absolute temperature, then $E = a\,T^4$ where $a = 1{\cdot}28 \times 10 - 12$.

(*b*) *Wieu's Displacement Law.*—The spectrum of black body radiation corresponding to any temperature can be readily obtained by passing the radiation through a fluorite prism, which is transparent to the infra-red rays. If the energy corresponding to every wave-length in the spectrum is now measured, it is possible to plot a curve showing the relation between energy and wave-length for a known temperature of the black body. Curves obtained in this way are called energy curves. A number of curves for different temperatures are given in fig. 1. An examination of

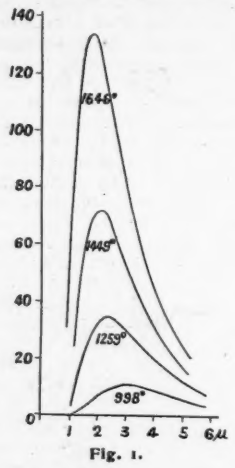


Fig. 1.

these curves shows that every one has a maximum value, and also that the maximum shifts towards the violet end of the spectrum as the temperature increases. Wieu, by thoretical reasoning. was able to prove that if the temperature of a black body is raised, every wave-length is diminished in such a way that the product of wave-length and temperature is constant. If $\lambda_o$ $T_o\lambda$ T are corresponding wave-lengths and temperatures, then Wieu's law states that $\lambda_o\ T = \lambda\ T =$ constant. If $\lambda_o$ is the wave-length of maximum energy corresponding to a temperature $T_o$, and $\lambda$ the wave-length of maximum energy corresponding to a higher temperature T, it follows immediately from the relation $\lambda_o\ T_o = \lambda\ T$ that $\lambda$ must be smaller than $\lambda_o$. The above expression, therefore, shows that the wave-length of maximum energy moves towards the violet end of the spectrum as the temperature increases. If the wave-length is measured in microns, the value of the constant is 2900, and Wieu's displacement law can be expressed—$\lambda$ max T = 2900.

### Selective Temperature Radiation.

The radiation from all bodies other than black bodies is called selective radiation. In some cases the radiation does not differ widely from that of a black body, but in others the difference is very marked. If the energy curves for platinum are examined, one is struck with their resemblance to those of a black body. The wave-length of maximum energy shifts towards the violet end of the spectrum with increased temperature; and Wieu's displacement law holds if the constant is changed from 2900 to 2630.

The total radiation from a bright platinum surface increases as the fifth power of the absolute temperature. It therefore follows that, as the temperature is raised, the radiation from platinum will approach that of a black body. The temperature radiation from all bodies becomes more like that of a black body, and therefore less selective, as the temperature is raised. The energy curves of other sources of radiation flames (*i.e.*, Welsbach mantles) deviate much from those of a black body, and show more than one well-defined maximum in the spectrum.

### Luminescent Radiation.

Kirchoff's law, which gives the relation between the emissive and absorptive power of bodies, does not hold for luminescent radiation. This is found to be the case for the radiation of vapours of salts placed in the bunsen flame. The intensity of the yellow light emitted by a bunsen flame containing the vapour of common salt is found to be more than twice as great as the intensity of the light of the same wave-length in the spectrum of a black body at the same temperature. In this case, the radiation is regarded as being due, at least partially, to chemical luminescence. Another example of chemical luminescence is the light emitted by phosphorus undergoing slow oxidation.

It is usual to include under luminescence the phenomena of fluorescence and phosphorescence. Certain substances have the power, when excited by light of a certain colour, to emit light of a different colour. In the case of liquids and gases, the emitted light generally ceases when the exciting radiation is removed; and the phenomenon is called fluorescence. In the case of solids, the emission of light continues for an appreciable time after the removal of the incident light; and the phenomenon is called phosphoresence. There is, however, no sharp line of demarcation between the two cases. Stokes, as the result of a large number of experiments on fluorescent substances, found that the wave-length of the emitted light is always greater than that of the exciting radiation. Recent work has, however, shown that there are marked exceptions to Stokes's law. Nichols and Meritt [" Physical Review," June, 1904], who measured the distribution of light-intensity in the fluorescent spectrum, found that the position of maximum intensity was independent of the wave-length of the exciting radiation. The intensity of fluorescence produced by light of much greater wave-length than that of the centre of the fluorescent band was quite strong.

### Efficiency and Energy Curves of Flames.

In a flame all the energy consumed is not converted into radiation. A large percentage of the energy is lost by convection and conduction. The efficiency of a flame as a source of light is measured by the ratio of the total luminous energy radiated per second to the total energy consumed per second. Another quantity which is often measured is the ratio between the total luminous energy radiated per second and the total energy radiated per second. In what follows, the former quantity is called the luminous efficiency, and the latter the radiant efficiency. The latter quantity is readily obtained by dividing the area of the energy curve included between ·41$\mu$ and ·76$\mu$ by the whole area of the curve. It is important to remember that these curves have been obtained by converting the energy obtained in each wave-length into heat, which is then measured. A certain quantity of energy in the yellow part of the spectrum will produce the same effect on our measuring instruments as the same quantity in the violet part of the spectrum. In actual practice, the eye is the measuring instrument; and it is well known that the sensibility of the eye to radiation depends on the wave-length, and also upon the intensity. The sensibility curve has a single maximum, and slopes off very steeply at first, and then very gradually towards the extreme red and violet ends of the spectrum. The maximum of sensibility for low intensities lies between ·5 and ·52$\mu$; and for moderate and high intensities the maximum shifts towards the yellow. The efficiency as defined above is therefore not what is actually required, because no account has been taken of the fact that the sensibility of the eye is a function of the wave-length. An efficient source of light should have its maximum energy in the yellow green.

The radiation from flames is due to incandescent carbon particles, and also the products of combustion (carbon dioxide, water vapour). The former give continuous spectrum, and the latter well-defined emission bands.

It is now proposed to give an account of some of the results which have been obtained by experiments carried out on the amyl-acetate flame, the ordinary gas-flame, and the acetylene flame.

### Amyl-Acetate Flame (Hefner Lamp).

The radiant and luminous efficiencies of this low-temperature flame (1431° C.) have been measured. The radiant efficiency was found to be 0·96 per cent., and the luminous efficiency 0·092 per cent. These measurements show that the Hefner lamp is a very inefficient source of radiation—less than one-tenth of one per cent. of the efficiency of combustion being transferred into visible energy. These values of the radiant and luminous efficiencies also show that only 9·5 per cent. of the energy of combustion is converted into radiation. The remainder (90·5 per cent.) is lost by convection and conduction.

### The Ordinary Gas-Flame.

The distribution of energy in the spectrum of the ordinary gas-flame was studied by Stewart [" Physical Review," Vol. XV., pp. 306-315]. The energy curve fig. 2 obtained by him is reproduced in curve 2, fig. 2. The small protuberances in the curve at 1·46 $\mu$ and 1·90 $\mu$ are due to the emission bands of water vapour; and the point of maximum energy is situated at 1·13 $\mu$. Stewart employed Wieu's displacement law $\lambda$ m T = constant to determine the temperature of the gas-flame. The value of the constant was calculated on the assumption that the incandescent carbon particles in the gas-flame behaved in exactly the same way as the same particles in the acetylene flame. From the known values of $\lambda$ m and T for acetylene, the constant could be determined; and the value obtained was then used in the determination of the temperature of the gas-flame. If the values of $\lambda$ m (1·13 $\mu$) and A (2282) are introduced in the equation $\lambda$ m T = A, the temperature of the gas-flame is calculated to be 2020° absolute or 1750° C. The value obtained by Nichols [" Physical Review," 1900, p. 234] by direct measurement with thermo-couples was 1780° C.

### The Acetylene Flame.

The energy curve of the acetylene flame was also investigated by Stewart, who found that the point of maximum energy was

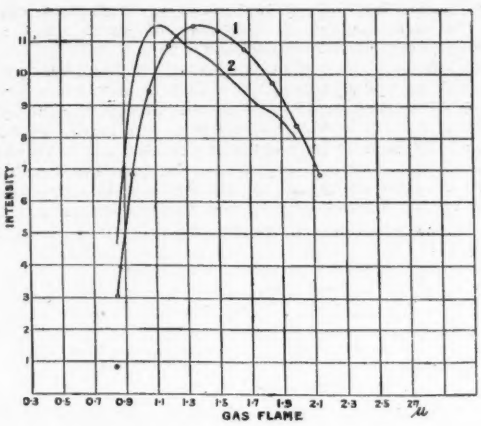



Fig. 2.

situated at $\lambda = 1{\cdot}05\ \mu$. If the flame is assumed to radiate like a black body, its temperature as determined from Wieu's law is 2527° C., and if assumed to radiate like bright platinum its temperature is 2232° C. Nichols determined the temperature of the flame by means of a thermo-couple, and found it to be 1900° C. Ladenburg, from measurements of the emissive and absorptive powers of the flame, found its temperature to be 1838° C. The above values calculated from Wieu's displacement law show that the incandescent carbon particles in the acetylene flame radiate more selectively than bright platinum.

Recently an extensive study of the emission and absorption of the acetylene flame has been carried out by Coblentz ["Bulletin of the Bureau of Standards," Vol. VII., p. 253, No. 2, 1911]. One of the interesting points investigated was the effect of the thickness of the flame on its emissive power. The energy curves of the flame radiating edgewise and also flatwise were obtained. The flat-flame readings were all multiplied by 9·6, and this made the two curves coincide throughout the visible spectrum. The results are shown in fig. 3, in which curve *a* represents the flame

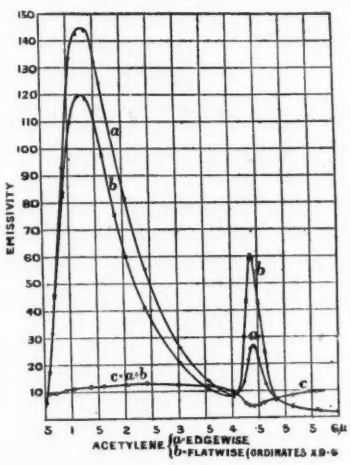



Fig. 3.

radiating edgewise, and curve *b* the flame radiating flatwise. The experiments indicate that the thickness of the flame has scarcely any effect on the shape of the curve in the visible spectrum. Outside the limits of the visible spectrum the two curves differ widely; and this difference, caused by the thickness of the radiating layer, accounts for the divergent values obtained for the radiant efficiency of the acetylene flame. According to Stewart, the radiant efficiency is 3·9 per cent., and according to Angstran 5·5 per cent. The point of maximum energy is situated at 1·25 $\mu$. The strong emission band at 4·4 $\mu$ is due to carbon dioxide.

The absorption of the acetylene flame for radiations of different wave-lengths was also investigated by Coblentz. The previous experiments of Ladenburg had shown that the incandescent carbon particles in the flame absorb a great deal in the visible spectrum, and less in the infra-red. Ladenburg had not investigated the variation of absorption with wave-length in the region of the visible spectrum extending from ·4 $\mu$ to ·7 $\mu$, and this gap was filled by Coblentz. The results are shown in curves *a*, *b*, and *c*, fig. 4. The curves were obtained under different experimental conditions, such as various thicknesses of flame. Curve *b* is interesting, as it indicates the presence of an absorption minimum in the region ·48 $\mu$ to ·5 $\mu$. All curves give an absorption maximum at ·6 $\mu$. The incandescent carbon particles in the acetylene flame therefore give a band of selective absorption with a maximum at ·6 $\mu$.

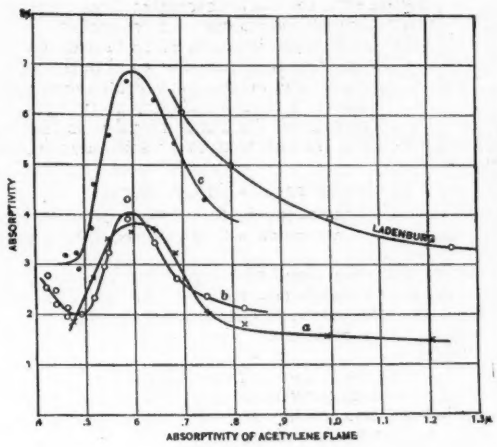



Fig. 4.

## The Welsbach Mantle.

This source of light was invented in 1885, by Auer von Welsbach, who noticed that a cotton fabric impregnated with a solution of nitrates of the rare earths emitted a brilliant light when introduced into the bunsen flame. After a lengthy series of experiments, he came to the conclusion that the best results were obtained with a mixture containing 99 per cent. thoria and 1 per cent. ceria. Subsequently, many researches were carried out with the object of determining the true cause of the brilliancy of the light; and several hypotheses were put forward to account for it. It was assumed that the mantle emitted luminescent radiation; the intensity of the radiation being greater than that of a black body at the same temperature. This assumption was, however, disproved by several experimenters. Bunte compared the emissivities from carbon, magnesia, thoria, ceria, and the Welsbach mixture when placed inside a carbon-tube electric furnace heated to about 2000° C. There was scarcely any difference in the radiation from these substances, and as a consequence the Welsbach mixture did not emit luminescent radiation. The same result was also obtained by Le Chatelier and Boudouard, who compared the brightness in different regions of the spectrum of the light emitted by various oxides when placed in the bunsen flame. The oxides examined by them consisted of ceria, thoria, the Welsbach mixture, black oxide of iron, uranium oxide, and lanthanum oxide. The temperature was measured by covering a thermo-junction with the oxide under examination. It was found that the radiation from the Welsbach mixture was greater in the red, green, and blue than the corresponding radiations from the black oxide of iron (black body).

However, it must not be concluded that the emissivity of the mixture is greater than that of a back body, because the temperature of the former was found to be 300° C. above that of the latter. If the black body was at the same temperature as the Welsbach mixture, its emissivity would be greater for all colours. In these experiments, the brightness of the light emitted in the red, green, and blue by the various oxides was compared with the brightness of the light of exactly the same colours by molten platinum. In the case of the Welsbach mixture, the relative brightness diminished from blue to red; but in every other case it increased.

Nernst and Bose, by comparing the light from the mantle with that of an incandescent lamp, showed that the emissivity of the former is low in the red. They also found that the flame gases had no effect on the emission from the mantle. This was done by making a thin rod of the material of the mantle, and heating it electrically to the same temperature as the mantle. The radiation was the same as for a mantle placed in the bunsen flame.

Another hypothesis which was put forward to account for the high luminosity of the mantle was catalysis. The action of the mantle was supposed to be similar to that of platinum black on a coal-gas flame. If platinum black is held over a gas-jet, it has the power of causing the rapid combination of the gas and the oxygen of the air, with the result that the gas is ignited. Lewes ["Chemical News," 1905, Vol. 91, p. 62] describes a similar experiment with the Welsbach mantle. On this hypothesis, the high luminosity of the mantle is due to its action in promoting more rapid combustion, and consequently producing a higher temperature than would be possible in a mantle of pure thoria. However, no explanation has been given of the fact that the most efficient mixture in producing this catalytic action consists of 99 per cent. thoria and 1 per cent. ceria; and the experiments on the temperatures of the flame and mantle are on the whole against the hypothesis of increased temperature.

White and Travers ["Journal Society Chem. Ind.," Vol. XV., p. 1012] showed that the mantle was about 130° C. below the temperature of the flame, and that the temperature of the Welsbach mantle was lower than that of a mantle made of pure thoria. Rubens made a careful determination of the temperature of the mantle, and found that the maximum values for the mantles examined varied from 1560° to 1590° C. The temperature of the bunsen flame 2·5 centimetres above the edge of the burner was

measured by Schmidt, and found to vary from 1597° C. for the centre to about 1800° C. for the edge.

The radiation of the Welsbach mantle was made the subject of two important papers by Rubens. He determined the energy curves of the mantle and of the bunsen flame alone. These curves showed that the mantle was practically transparent to the radiation from the bunsen flame, and consequently the energy curve of the mantle alone could be obtained by subtracting the second curve from the first. The curve obtained in this way showed two maxima—one at 1·25 $\mu$, and the other at 9·25 $\mu$. Rubens also compared the emissivity of the mantle with that of a black body at the same temperature. The emissity in the visible spectrum was always less than 1; being ·85 for blue light and about ·1 for red. The experiments also showed that the emissivity of the mantle in the infra-red, especially betweed 1 $\mu$ and 6 $\mu$, was very low. The experimental results are shown in fig. 5.

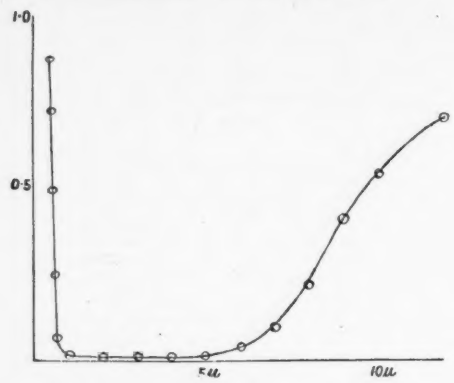



Fig. 5.

The luminosity of the mantle is greatly affected by the amount of ceria it contains; and to investigate this point Rubens determined the energy curves of mantles made of pure thoria and pure ceria respectively. The pure ceria mantle was found to radiate far more in the infra-red than the Welsbach and thoria mantles. The energy curves of the two latter mantles were almost identical in the infra-red, but differed in the visible spectrum. The amount of ceria which is added to the thoria in the mantle has the effect of increasing the luminous radiation without appreciably altering the dark heat radiation. The effect of increasing the percentage of ceria from 8 to 5 was to lower the temperature of the mantle from 1560° to about 1400° C. The addition of too much ceria, therefore, increases the heat radiation and diminishes the temperature.

Coblentz ["Bulletin of Bureau of Standards," 1911, Vol. VII., No. 2, p. 274] clearly shows that increasing the thickness of the radiating layer has the same effect as increasing the percentage of ceria. The materials of the mantle were made into thin rods 12 millimetres long, and 0·7 millimetre diameter, and heated electrically. One of these glowers was operated on 24 watts, so as to give the same emissivity as the mantle in the green, and afterwards on 22 watts, so as to give the same emissivity as the mantle

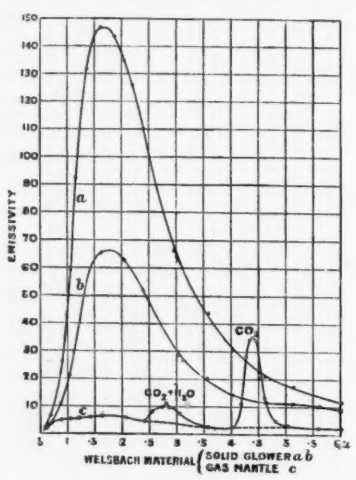



Fig. 6.

n the red. The energy curves of the glower under the two specified conditions and of the mantle are given in fig. 6, curves *a*, *b*, and *c*. From these curves, it can be deduced that the solid glower emits 8·5 times as much energy as the mantle in order to attain the same emissivity in the green. Under these conditions, the glower emitted in the visible spectrum about 2·5 times the energy radiated by the mantle in the visible spectrum, but the quality of the light was defective, as it contained too much red.

The result of these experiments is that a mantle has a far greater efficiency than a thick glower of the same material. The latter would have to be heated to a much higher temperature than the mantle to attain the same efficiency. The radiant efficiency of the mantle, according to Rubens, is 2 per cent. The radiant efficiency of a black body at a temperature of about 1730° C. is 1·7 per cent., and it would be much less at 1590° C., which is the temperature of the mantle. The comparatively high efficiency of the Welsbach mantle is due to the fact that it radiates very selectively. Confining our attention now to temperature radiation, the efficiency of a source of light can be increased either by raising the temperature or by employing a substance which is more selective than the Welsbach mixture. In the case of the mantle, the temperature has been increased by employing high-pressure gas, which makes it possible to obtain the theoretical mixture of air for complete combustion.

In this connection, it is important to point out that the photometric intensity of light increases very rapidly with the temperature. According to Nernst, the following relation holds between the intensity H and the absolute temperature T for a black body:

$$\log H = B - \frac{A}{T}$$

Where H = the total light in Hefners per square millimetre, B = 5·367, and A = 11230.

The Hefner is the unit of light, and is defined as the light which a Hefner lamp radiates per second on a surface of 1 square centimetre at a distance of 1 centimetre. The rapid rise in the photometric intensity with increase of temperature is well shown in the accompanying table.

| Absolute Temperature. | | Light in Hefners per sq. mm. |
|---|---|---|
| 1464° | .. | ·005 |
| 1524° | .. | ·01 |
| 1685° | .. | ·05 |
| 1764° | .. | ·10 |
| 1582° | .. | ·50 |
| 2092° | .. | 1·0 |
| 2287° | .. | 2·0 |

Bodies showing marked selective emission and absorption belong to the group of substances known as the rare earths. These substances, because of their high melting-points and small volatility at the temperature of the flame, are very suitable radiators. Unfortunately, however, it is a very difficult and tedious matter to separate and purify these substances. If suitable bodies emitting luminescent radiation when introduced into the non-luminous bunsen flame could be obtained, it would be possible to get higher efficiencies than we have at present.

In this lecture, only a brief account of some of the important experiments has been given; and those who wish to pursue the subject further should consult the original papers cited in this lecture.

## MID-RHENISH ASSOCIATION OF GAS AND WATER ENGINEERS.

### Annual General Meeting.

The "Journal für Gasbeleuchtung" of the 2nd inst. contains a report of the proceedings at the forty-ninth annual meeting of this Association—held at Bad-Nauheim on Sept. 14 to 16. The following is a brief summary of the report of the proceedings.

The meeting was attended by over 200 members and friends. On Saturday, Sept. 14, visits were paid to the springs and baths, to the electricity works, and other places of interest. In the evening, the visitors were entertained by the Municipality at the Sprudel Hotel.

The formal proceedings were opened the following day in the Kurhaus by the President of the Association (Herr Göhrum, of Stuttgart.) The visitors were welcomed by Herr Schliephake on behalf of the Minister of the Interior of the Grand Duchy of Hesse, and by Dr. Kayser, the Burgomaster of Nauheim, in speeches in which references were made to the activities of gas and water engineers in the district. The President, after thanking the speakers for their words of welcome, proposed the names of officers for election for the ensuing year, and of the town of Colmar for next year's meeting. The fiftieth anniversary of the foundation of the Association will be celebrated in 1914, at Neustadt, where the Association was formed in May, 1864. The annual report of the Association was then presented by the President, who proceeded to review the general position of the gas industry at the present time. Statistics showed, he said, that in Germany the increase in gas consumption for 1910, as compared with the preceding year, was, on the average: "In 78 towns with less than 10,000 inhabitants, 7 per cent.; in 192 towns with from 10,000 to 50,000 inhabitants, 5·9 per cent.; in 42 towns with from 50,000 to 100,000 inhabitants, 6·7 per cent.; in 47 towns with from 100,000 to 250,000 inhabitants, 5 per cent.; and in 18 towns with more than 250,000 inhabitants, 6·4 per cent. Electricity works had not attained so great an increase in output.

It was significant of the future of the gas industry that new gasworks were constantly being provided in rural districts which were already supplied with electric current. As regarded the conditions of supply of gas and electricity by municipalities, he was of opinion that electricity, which was more especially used for lighting by the well-to-do classes, should not be supplied on a less remunerative basis than gas, which was more generally consumed by people of

small means. The competition of electricity had been beneficial to gas in that it had led to the introduction of novelties by which the manufacture of gas was cheapened. As regards the quality, formerly there was something approaching unanimity as to what constituted illuminating gas; but now the gas supplied varied in calorific power from 545 to 461 B.Th.U. per cubic foot. He was opposed to the resolution which had been passed at an earlier meeting, to the effect that gas of about 524 B.Th.U. per cubic foot was the most desirable. He would rather return to gas of higher grade. He hoped that this point would be discussed by the members.

Other questions which were of importance for the technical development of the industry were the use of central producers and low-grade fuel for heating settings, the employment of a more refractory material with greater heat conductivity for the manufacture of retorts, the extraction of sulphur impurities from gas by washing, the working-up of tar on gas-works, and improvements in appliances for the use of gas. The Central Publicity Organization had already done much good propaganda work for the gas industry.

After some references to water supply matters, the President referred to the changes during the year in the membership of the Association. The loss of members by death had been compensated by the election of new ones; the result being that the new year commenced with a roll of 7 honorary members, 117 members, and 154 associates—a net gain of two on the total membership twelve months earlier.

At the conclusion of the President's address, Herr Röder, of Nauheim, gave an account of the supply of that town with water and light. Herr Nübling, of Stuttgart, then read a paper on new systems of coal-sheds, on which a short discussion ensued. The general view appeared to be that more attention should be paid to the provision for the storage of coal. The next communication was a paper by Herr Petsch, of Berlin, on high-pressure gas lighting. It gave an interesting review of the developments of lighting appliances, and drew attention to a new method of cross suspension for street-lamps. Herr Alberts, of Berlin, in the discussion, referred to the widely different photometric results reported for high-pressure gas-lamps in different towns, and suggested that in such reports the composition or character of the gas used should be stated more precisely, as some light might thus be thrown on the differences. Herr Haas, of Mayence, described a new prepayment-meter mechanism which admitted of the mechanism being altered to suit different prices of gas. Herr F. Lux, of Ludwigshafen, then referred to the M'Lean furnace, with compensating draught.

These communications concluded the morning's proceedings, and the afternoon was mainly devoted to questions of water supply. After all the papers had been read, a free discussion on various subjects ensued. Herr Eisele, of Cassel, advocated the raising of gas pressures, and reported that increased pressure in Cassel had been followed by good results. Herr Helck suggested that, in view of the importance of the question, a Committee should be appointed to report on the advantages and disadvantages of high gas pressure. Herr Förtsch confirmed the advantages of increased pressure, and Herr Frahm mentioned some American experiences with cast-iron mains at high pressure. The President said that he would report the suggestions made to the parent Association—the German Association of Gas and Water Engineers. The proceedings concluded with the presentation and passing of the accounts, and votes of thanks to the officers.

In the evening, a banquet was held in the Kurhaus. On Monday, Sept. 16, visits were paid in two groups to local works, and, in the afternoon, an excursion was made to Homburg, and thence, by the electric railway, to the Salburg, where the restored Roman city was inspected.

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**Gas from Australian Shale.**—A patent has been taken out for Germany, by Herr J. Becker, for a process for the manufacture of a normal lighting and heating gas from Australian bituminous shale. According to an abstract of the specification in the "Journal of the Society of Chemical Industry," carbonization is effected at a temperature not exceeding 1000° C., in retorts which are filled gradually while the operation is proceeding, and into which steam is admitted. The gases produced are heated in the same or in a second retort with a further supply of steam. In this way normal lighting and heating gas can be obtained from Australian shales, which have hitherto only been useful as additions in the manufacture of coal gas for the purpose of increasing its illuminating power.

**Society of Arts.**—The arrangements for the forthcoming session of the Society, which will open to-morrow week with an address by Lord Sanderson, G.C.B., K.C.M.G., the Vice-President and Chairman of the Council, are of more than usual interest to "JOURNAL" readers. A course of three Cantor Lectures will be delivered by Professor Vivian B. Lewes, F.I.C., F.C.S., on "Liquid Fuel;" and another of two lectures by Mr. F. W. Goodenough, on "Coal Gas as a Fuel for Domestic Purposes." The dates of the former lectures are the 2nd, 9th, and 16th prox., and those of Mr. Goodenough's, the 3rd and 10th of March, 1913. The following are among the papers to be read after Christmas: "The Economic and Hygienic Value of Good Illumination," by Mr. L. Gaster; "Steel Pipes *versus* Cast-Iron Pipes for the Conveyance of Gas, Water, and Air," by Mr. C. L. MacCarthy; and "Co-Partnership," by Mr. Aneurin Williams.

## GAS-RETORT MANUFACTURE.

**[From the "Brick and Pottery Trades Journal," Nov. 2.]**

Why does the Continental method of gas-retort manufacture differ so radically from that of England and Scotland, and how is it that, with inferior raw materials, the Continental makers are able to obtain so much better results? These two questions repeatedly arise in the minds of gas engineers and others who are interested in the subject from a seller's or user's standpoint; but they seldom appear to occur to the manufacturer himself. Yet upon a satisfactory answer to such questions must the success or failure of the British gas-retort manufacturers depend. A simple comparison of the principles underlying the methods of manufacture in the two areas will soon show the reason for the difference in the products.

In Britain, the manufacturer uses the materials that lie to hand, without much regard to their nature. The fire-clay that was satisfactory twenty years ago must be equally so to-day—at least, that is the Briton's argument. He therefore concentrates his attention on selecting the most suitable portions of the fire-clay seam for his purpose, adds as much grog as he thinks is desirable, and proceeds to make a paste from which the retorts can be fashioned.

On the Continent, so simple a procedure is not practicable, for the fire-clays there do not, as a rule, permit themselves to be worked direct. Besides, the demands of the gas engineers and other users of refractory goods are much more severe, because most Continental gas engineers have a far more thorough knowledge of investigational methods on rigid scientific lines than those in this country, and are, therefore, more intelligently insistent that the retort manufacturers shall keep pace with their requirements. In addition to this, the retort manufacturers themselves employ men who are not merely college students as their chemists and technical advisers, but insist on such men having ample technical experience gained in the works. The technical schools for clay working are staffed by men who have been well trained in the various practical processes, and not by those of merely academic requirements; and these schools exist in sufficient numbers to be able to specialize on the needs of a district.

Instead of insisting on the use of a clay in a particular locality where the works may be situated, as is the case in this country, the Continental retort manufacturer buys his materials where he needs them, just as the potters in Staffordshire do their clays, flint, &c. The result is that they are able to make a selection of materials and to use mixtures which would never be dreamed of in this country. In brief, by the aid of really skilled men who are experienced technologists as well as chemists, the various properties of the materials to be used are first studied; mixtures in which the good properties shall be used to the full and the bad ones eliminated as far as possible are then devised; and the products are tested in all sorts of ways, to ensure that they are the best possible for the purpose.

British manufacturers of retorts undoubtedly endeavour to make improvements in their goods; but they do not do so with the same degree of system or of scientific control as is customary on the Continent. One reason for this difference is that several British firms believe that it does not pay them to make use of this scientific assistance; and if they are so progressive as to obtain it, they endeavour, for the sake of cheapness, to employ young chemists fresh from college or technical school, whose knowledge, even of the chemistry of clays, must be extremely elementary, and whose acquaintance with the complex problems of the clay-worker must be insignificant. The firms engaged in retort manufacture on the Continent are usually very large; the small firms met with in this country could not exist. Even some of the largest here are not as large as some of the Continental ones, as far as retort manufacture is concerned; or with most British firms it is a side issue, instead of being the chief work. The very size of some of the Continental firms enables them to secure the services of able technical men in a manner that is almost impossible for most of the British makers of retorts.

The result of the technical control of the industry on the Continent has resulted in a study of the requirements of the user to an extent little thought of in this country, and has resulted in a method of manufacture quite unknown here. One of the first discoveries resulting from a technical investigation of retorts in use was the necessity of employing a material which would shrink as little as possible during the firing in the kiln. It was found that clays with a considerable shrinkage invariably produced a dense retort, and one that would not prove sufficiently durable in use. British makers have since expressed this by saying that retorts must have a certain amount of porosity, but they have failed to see the significance of the absence of contraction or shrinkage in the course of manufacture as one of the essentials of which porosity is merely an indication.

A further discovery was made when means were found for eliminating unsuitable material in a satisfactory manner. The British practice has been to employ one or more men to pick over the raw clay and to throw out any nodules of pyrites and other undesirable impurities. These men have been trusted implicitly to do their work in an honest manner; but the difficulties involved result in the picking being done very imperfectly, even by the most painstaking men, with the result that many retorts are spoiled, or at least reduced in value, by particles of iron slag.

British retort manufacturers have never realized that by first

heating the raw clay to a temperature higher than that likely to be reached in the use of the retorts they could convert it into a clean, cream-coloured material from which the portions made impure by the presence of iron compounds could readily be removed. This practice has been in use for some years past by almost all the Continental makers of fire-clay goods; and as a result of it, the selected burned clay, in the form of lumps, is a regular article of commerce from the northern clayfields of Scandinavia to the southernmost works in Italy, under the international term "chamotte."

The raw fire-clay in lump form as it comes from the pit is fed into a tall kiln, not unlike those used for lime burning. The material is heated out of contact with the fuel [gas firing being preferable for this purpose], and the burnt clay is withdrawn at the bottom of the kiln. It is then carefully sorted; all discoloured lumps being thrown aside and all the largest lumps being broken to ensure that they do not contain a nodule of iron slag within them. The broken material is then freed from dust by screening, and is dispatched in trucks to the works. As the coalfields on the Continent are in many cases distinct from the clay-pits from which the best qualities of chamotte are made, the producers of this material suffer disadvantages which do not occur in Britain, and have to pay amounts in carriage which would be entirely saved here. In all cases the production of this burnt clay or chamotte is regarded as a distinct industry, just as the production of iron is separate from that of steel.

In place of chamotte, some Continental retort manufacturers employ a kind of china clay, the shrinkage of which is so small that it may be used in the raw state.

In Britain, the use of a plastic fire-clay enables the paste from which the retorts are fashioned to be prepared by simple grinding and admixture with water; a little grog being added according to the whim of the man in charge. On the Continent, however, the use of an entirely non-plastic material renders the use of a highly plastic clay as a binding material absolutely essential. At first sight, it appears as if the conversion of the clay into chamotte, and the subsequent addition to it of a more expensive highly plastic clay, was a ridiculous procedure; but further experience will show the contrary. In the first place, the preliminary burning enables the material to be sorted far more effectively and a larger proportion of the impurities to be removed; and, in the second, it destroys the shrinkage of the greater part of the material before it is made into the shape of a retort. In this way, it enables a material to be used for the bulk of the retort which has a structure best suited to the needs of the retort user—it enables the manufacturer to produce retorts of any desired degree of porosity and of such special texture as may best please the gas engineers for whom he works. With the bulk of the raw material in a plastic state, such as is commonly used here, there is little possibility of varying the texture as much as is desirable, and the porosity is limited because of the extremely small size of the grains of clay. If, previous to being made into a paste, these grains are agglutinated by heat, a material is produced in which the size of the grains is much larger, and may, in fact, be as large as is desired; their size being merely a matter of selection by sifting, whereas the use of a coarse sieve for raw clay is of little value, as much of the material is softened and reduced to its ultimate particles by contact with the water used in mixing. This breaking-up does not occur with burnt clay.

The following description of the process used at several Continental works is worthy of the attention of all British retort manufacturers: The raw materials used are a highly plastic binding clay (a variety of ball clay such as is found in Dorset), a very slightly plastic kaolin (a kind of china clay), and chamotte made by burning a high grade fire-clay as already described to a temperature corresponding to Seger Cone 14.

The kaolin and the binding clay are dried and placed in a large ball mill in suitable proportions, and are there ground as finely as possible. The chamotte is carefully sorted, and all discoloured pieces are thrown out, together with any underburned material, after which the chamotte is ground through rolls or in an edge-runner mill to pieces less than one-third of an inch in diameter. The production of fine powder is avoided as far as possible by careful arrangement of the scrapers on the edge-runner mill, as such fine powder is useless for gas-retorts, but may be employed in the manufacture of some other fire-clay goods. In the works in question, the upper limit of size of grain is determined by the perforations in the pan of the mill and the lower limit by a sieve having apertures 1-25th of an inch wide; all the material passing through the latter sieve is discarded as far as retorts are concerned.

The mixture of kaolin and binding clay from the ball mill is now placed on a flagged floor, and layers of the crushed chamotte and the clay mixtures are placed alternately until a convenient quantity has been obtained. The proportions of each must have previously been decided. They will depend on the nature of the plastic clay, of which as little as possible should be used, as it is only employed to give the desired strength to the mass. The materials are moistened, mixed roughly with wooden spades, and are then left overnight to "ripen." On the following day, the mixture is fed into a pug-mill or open mixer; and the paste is then piled up in a cool place, covered with cloths, and kept moist for a fortnight or more, so that the ripening may be continued and the plasticity of the binding clay and kaolin developed to the utmost. If the material is wanted in a hurry, it is passed through a brick machine, the paste cut into convenient sized blocks with wires, and then dried to the required stiffness in a warmed shed. The blocks are then piled together and well beaten with wooden tools into a solid heap. With some clays the latter method gives results superior to the former.

The shaping of the retorts follows the course ordinarily adopted in this country, and need not be described, except to point out that the much rougher material used is very severe on the men's hands, unless precautions are taken not to handle it without gloves except for finishing purposes. Some Continental makers become very expert in the use of small wooden shovels or scoops, with which they throw the paste on to the drum instead of tearing it from the heap with their fingers and then throwing it on by hand. The drying takes place in the making shop; great care being needed to ensure a uniform temperature to all parts of the retort. As soon as it is sufficiently leathery, the retort is turned, and the inside of it finished, and then painted over with a stiff paste made of chamotte dust and fire-clay dust, so as to give a thin, dense surface lining. If the retort is to be glazed inside, it is allowed to dry completely, and is then laid horizontally on a waggon. A youth carefully brushes out all loose dust, and then creeps cautiously inside and applies the glaze with a wide brush.

The burning of the retorts is similar in both the British and European methods, though there is a preference here for Newcastle kilns with horizontal draughts, whereas all Continental retorts are fired in down-draught kilns, usually of the continuous type. A serious objection sometimes urged against the adoption of the Continental method into Britain is that the plastic clay used requires to be both highly plastic and highly refractory—a pair of properties not usually occurring together in British clays, the most refractory of which are usually the least plastic. This objection is based on a misunderstanding of the purpose of the plastic clay, which is two-fold—viz., to bind the particles of non-plastic material together while the retort is being made, and also to bind them together in the finished and burned retort. As regards the first purpose, the clay must necessarily be highly plastic, for only a small portion of it can be used. For the second, on the contrary, a fusible material is needed which will form a kind of glass, and so bind the constituents of the retort into a strong mass. The proportion of this fusible matter present must not be large enough to interfere with the heat-resistance of the retort; but the fact that it is needed shows that the highly plastic clay need not necessarily be highly refractory. It is, indeed, better to be otherwise.

## CALORIFIC VALUE OF OIL GAS.

The members of the Pacific Coast Gas Association had their attention directed to the above-named subject, on the occasion of their last meeting, in a paper submitted by Mr. F. S. Wade. After a few introductory observations in reference to the value of the calorimeter for the purpose of testing gas, he made the following remarks.

Some time ago the writer was confronted with the problem of controlling the quality of gas sent out by four widely scattered plants, supplying ten even more widely scattered towns. Ordinances of one kind or another regulate the quality of gas in most of the towns, and, apart from this, it is the writer's firm opinion that satisfactory gas service can only be given where a reasonably high and (even more important) a moderately constant quality of gas is maintained.

It was out of the question to instal a complete calorimeter at each of the plants or cities involved; so other means were sought. The first idea entertained was to set up a calorimeter at some central point, and bring thereto samples large enough to permit of calorimeter tests. As a means of taking such tests, a rubber bag was first tried. It is pretty generally understood that rubber will absorb portions of illuminating gas, and permit the diffusion of air through the walls of the container. Nevertheless the following experiment was performed to determine just how serious the error was, and if it could be corrected. A 16-inch main-stopper bag was filled with gas, emptied until flat, refilled, and tested, with the following results:

| Material. | B.Th.U. by Calorimeter |
|---|---|
| Original gas from pipes | 613 |
| Gas from bag 10 minutes after filling | 592 |
| Gas from bag 1 hr. 30 min. ,, ,, | 562 |
| Gas from bag 18 hours ,, ,, | 559 |

It is hardly necessary to say that the error indicated by these figures is too great to admit of correction; so we may state that a rubber bag is utterly worthless as a means of sampling illuminating gas.

Samples were next taken by displacing water in a 5-gallon bottle, which was found inadequate in size and the method generally unsatisfactory. A 30-gallon water-tank was equipped with an exhaust and condenser pump which would draw gas from a line and discharge it into the tank, where it was finally compressed to 20 lbs. to the square inch. The work of displacing the gas or air already in the tank proved very tedious, and the tank itself was cumbersome. The results obtained by this method were, however, accurate, and it is the only one to be recommended for taking a sample large enough to make an actual calorimeter test.

Time and labour must be no serious object where this method is adopted.

Reluctantly, the writer turned to volumetric gas analysis as a possible solution of his problem—reluctantly, because he had for years been sceptical as to the real utility of gas analysis performed over water and on samples taken in the usual glass tubes. That his fears were ill-founded is proved by what followed. Samples of gas were taken in the usual form of tube, having a stopcock at each end and a capacity of about 250 c.c. After some experiment, vaseline was adopted as a lubricant; it being obtainable anywhere and of constant quality. The joint made, when it is used, is perfectly tight to moderate pressure differences. Fresh gas from the main was allowed to blow through the tube for two minutes, when the outside cock was closed, followed by the inside one. Samples taken in this manner were sent to the laboratory and transferred to the gas-analysis apparatus by displacement with distilled water. Care was taken to exclude air from all the connections, either by filling with water or by purging with the gas itself.

The effect of water upon gas samples was tested as follows: Simultaneous samples were taken in two dry tubes; one remained dry, while the second was half-filled with fresh distilled water, shaken up, and allowed to stand 18 hours with the broad surface of the water exposed to the gas.

*Original Gas*, 603 *B.Th.U. by Calorimeter.*

| | Sample Dry Tube. | Tube with Water. |
|---|---|---|
| Carbon dioxide | 2·4 | 1·4 |
| Illuminants | 3·5 | 3·2 |
| Oxygen | 0·4 | 0·6 |
| Carbon monoxide | 10·2 | 10·0 |
| Hydrogen | 52·7 | 52·6 |
| Methane | 29·0 | 29·5 |
| Difference | 1 8 | 2·7 |
| | 100·0 | 100 0 |
| B.Th.U. calculated by constants to follow | 597·0 | 595·0 |

It will be seen from these figures that the loss in calculated heating value on account of exposure to water is not serious, as the only material change is in the carbon dioxide, which has no heat value. This change, however, suggests the possibility of serious error in the analysis itself, on account of carbon dioxide, formed by the explosion of methane, being absorbed by water in the burette. This error is obviated by making a number of blank explosions in the burette, and not changing the water after it has thus become saturated with carbon dioxide. It is very important that the water in the burette should not be alkaline.

The effect of long standing upon samples was tested as follows: Simultaneous samples were taken in two tubes; one was analyzed immediately, but the other stood for 23 days.

*Original Gas*, 590 *B.Th.U. by Calorimeter.*

| | Immediate Sample. | After 23 Days. |
|---|---|---|
| Carbon dioxide | 0·8 | 0·6 |
| Illuminants | 2·7 | 2·8 |
| Oxygen | 0·4 | 0·2 |
| Carbon monoxide | 4·9 | 5 0 |
| Hydrogen | 58·8 | 60·4 |
| Methane | 29 8 | 29·4 |
| Difference | 2·6 | 1·6 |
| | 100·0 | 100·0 |
| B.Th.U. calculated | 590 0 | 593·0 |

The slight change shown indicates nothing more than experimental error; so we may conclude that samples thus taken may be kept with perfect safety for three weeks without being analyzed. For the analysis, a slightly modified Elliot apparatus was selected as meeting the requirements in speed and simplicity. The general method of procedure was the same as recommended in text-books describing the apparatus. Enough pure bromine—not bromine water—was used to fill the absorption-tube with dark fumes. Oxygen (90 per cent.) was used for the explosion, in the proportion of one of residue to three of oxygen. Repeated experiments with air, in proportions varying from five to nine of air to one of residue, failed to give complete combustion. In no case was the full amount of methane shown where air was used for the explosion. Great care must be exercised to obtain complete absorption of carbon monoxide, as any not removed appears later as methane, making the analysis worthless.

We now come to the all-important question of the constants to be used in calculating the heating value of gas from its analysis. In April, 1893, the "Journal of Analytical and Applied Chemistry" published an excellent and authoritative paper on "Fuel Value of Gases," by Mr. Henry L. Payne. This paper was later reprinted in Stillman's "Engineering Chemistry" and widely quoted elsewhere. It gives the following values per cubic foot for the more common gases, at 32° Fahr. and 30 inches of mercury.

| | |
|---|---|
| Hydrogen | 345·4 |
| Carbon monoxide | 341·2 |
| Methane | 1065 |
| Illuminants | 2000 |
| Ethane | 1861 |
| Propylene | 2657 |
| Butylene | 3441 |
| Benzene | 4012 |

As is well known, 32° Fahr. is never used as a standard in commercial gas work; 60° Fahr. being the temperature universally assumed in such work, and particularly in reporting the heating value of gas determined by a calorimeter. Notwithstanding this fact, the figures given above are largely used in calculating the heating value of gas from analysis. A comparison of figures so obtained with the results of a calorimeter test corrected to 60° Fahr. is, of course, meaningless.

When the above figures are corrected to 60° Fahr., they become, in round numbers:

| | |
|---|---|
| Hydrogen | 323 |
| Carbon monoxide | 319 |
| Methane | 996 |
| Illuminants | 1871 |
| Ethane | 1741 |
| Propylene | 2486 |
| Butylene | 3227 |
| Benzene | 3753 |

Now let us see what results are obtained if we sample and analyze oil gas according to the method outlined above, calculate the heating value, and compare it with calorimeter tests. The following samples were taken from pipes simultaneously with tests made on a Junkers calorimeter:

| | | | |
|---|---|---|---|
| Carbon dioxide | 2·2 | 2·2 | 0·4 |
| Illuminants | 3 4 | 3·8 | 4 2 |
| Oxygen | 0·4 | 0·4 | 0·5 |
| Carbon monoxide | 10·6 | 10·2 | 4·1 |
| Hydrogen | 50·2 | 49·1 | 52·6 |
| Methane | 30·9 | 32·1 | 35·4 |
| Difference | 2·3 | 2·2 | 2·8 |
| | 100·0 | 100·0 | 100·0 |
| B.Th.U. by calorimeter | 608·0 | 623·0 | 660·0 |
| B.Th.U. calculated | 567·0 | 582·0 | 613·0 |

The value obtained by these constants is almost exactly 7 per cent. lower than that shown by the calorimeter. Two courses are open to us – to use the constants stated, and arbitrarily increase the figure obtained by them, or change the constants, paradoxical as this may seem. The latter course was deemed advisable.

Hydrogen and carbon monoxide are gases of definite composition, the heating values of which have been well established. There is no need, therefore, to alter their constants. The illuminants, however, are made up of an undetermined mixture of hydrocarbons varying in heating value from 1700 to 4000 B.Th.U. per cubic foot. We may then change the value assigned to them to meet conditions. Methane, while a definite gas, is determined indirectly and by a method subject to error. Its value, therefore, has been somewhat increased. After many experiments on various oil gases, the following constants were adopted:

| | |
|---|---|
| Illuminants | 2300 |
| Hydrogen | 325 |
| Carbon monoxide | 320 |
| Methane | 1080 |

The tests given below show comparative results obtained when using the above constants and a calorimeter. All the samples are "straight" oil gases; those bearing the same letter being made by the same plant and process, but at different times.

| — | A. | A. | A. | A. | B. | B. | B. | B. | C. |
|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 2·2 | 2·2 | 1·7 | 2·2 | 0 8 | 0·2 | 0·4 | 0·1 | 0·4 |
| Illuminants | 3·6 | 3·4 | 3·3 | 3 8 | 2·7 | 2·5 | 4·2 | 4·5 | 2 7 |
| O | 0·4 | 0·4 | 0·3 | 0·4 | 0·4 | 0·3 | 0·5 | 0·5 | 0·3 |
| CO | 10·8 | 10·6 | 10·0 | 10·2 | 4 9 | 5·2 | 4·1 | 3·9 | 5·7 |
| H | 50 8 | 50·2 | 49·9 | 49·1 | 58·8 | 60 0 | 52·6 | 48·4 | 63·2 |
| $CH_4$ | 30·2 | 30·9 | 31·8 | 32·1 | 29·8 | 30·6 | 35·4 | 40·3 | 27·7 |
| Difference | 2·0 | 2·3 | 3·0 | 2·2 | 2·6 | 1·2 | 2·8 | 2·3 | 0·0 |
| | 100·0 | 100·0 | 100·0 | 100·0 | 100 0 | 100·0 | 100·0 | 100·0 | 100·0 |
| B.Th.U. (*a*) | 593 | 608 | 609 | 623 | 590 | 609 | 660 | 710 | 590 |
| B.Th.U. (*b*) | 605 | 609 | 613 | 626 | 591 | 600 | 663 | 708 | 585 |

(*a*) Calorimeter. (*b*) Calculated.

The agreement shown here is unquestionably satisfactory; and it is recommended that the constants given should be used where oil gases are sampled and analyzed by a method similar to the one mentioned. If lower constants are employed, a certain injustice will be done to the gas.

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**Manchester Public Lighting.**—Under the heading of "Electrical Notes" in the Engineering Supplement to "The Times" last Wednesday, an engineering correspondent wrotes as follows on the above-named subject: "On all practical points it would appear that the reports of the two experts, Mr. Haydn T. Harrison and Mr. Jacques Abady, on the lighting efficiency and economy of two selected streets in Manchester are in agreement; and the stubborn adherence of this municipal council to a gas monopoly for public illumination stands condemned. Mr. Abady, however, endeavours to divert the general inquiry from a mere comparison of candle power and cost; and some of his claims on behalf of gas deserve further examination. 'Apart from photometrical tests,' Mr. Abady insists that diffusion and 'visual brightness' ought to be considered; and 'it happens to be a fact . . . that in both these qualities gas lighting by mantles has a very distinct superiority over any form of arc lighting.' If 'visual brightness' means brilliancy at the burning-point, the special advantage is not very obvious; while as for diffusion, it would be convenient to have some form of test proposed, 'apart from photometrical,' before opinion can be allowed to become fact."

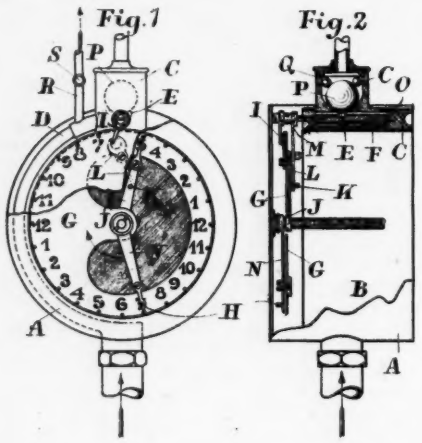
# AUTOMATIC LIGHTING AND EXTINGUISHING OF GAS-LAMPS.

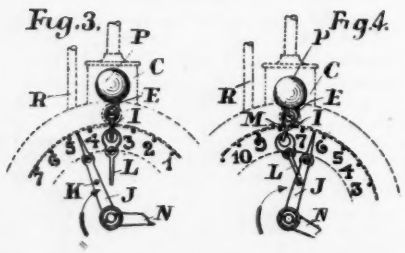
### Two French Clockwork Arrangements.

There have lately been published specifications of two patents for lighting and extinguishing public lamps by means of clockwork mechanism. The following particulars are translated from the specifications.

The first arrangement was devised by MM. Vogt et Cie., with the object of preventing, by employing sound and perfect mechanism, failures in action which occur in some automatic appliances for lighting and extinguishing lamps. It consists of a gas-valve placed above a box of clockwork, by which it is actuated at predetermined times. For example, a ball-valve is used which can be raised from its seat or allowed to fall back by means of a rotary horizontal shaft furnished with a lifting cam. The end of the shaft projecting from the valve-box has fixed to it two spaced fingers which can be moved by the catch hands of the clockwork to turn the cam-shaft, and thus cause the opening and closing of the valve.

The accompanying diagrams show the arrangement by which the inventors' object is attained; fig. 1 being a front view, fig. 2 a longitudinal section, and figs. 3 and 4 details intended to illustrate the action of the mechanism.




The case A contains clockwork mechanism placed in the box B and a gas inlet-valve C above the box; a gas feed-pipe D being branched on the base of the box, provided at the top with a nozzle to feed a burner. The inlet-valve C consists of a ball-valve worked by a cam E on the rotary horizontal shaft F. The clockwork comprises a dial G, divided into 24 hours (in two twelves), and having an opening extending over slightly more than a half circle, and fixed on the hour shaft of the clockwork. A hand with catch is placed loosely on this shaft, outside the dial, to which it is fixed in an adjustable manner by means of a screw. This hand can impinge, with its catch H, upon a working finger I on the rotary shaft F, and displace the latter at an angle to cause the opening of the valve to ignite the gas. There is also a loosely fitted hand needle with a catch J inside the dial, on the hour axis, and so fixed to the dial that it can be adjusted with a screw. A catch K, running inwards, impinges upon a fork balance-beam L pivoted on the box B, and catching with its higher fork a second working finger M fixed on the shaft F. The two hands N J are placed so as to form a kind of nipper, enabling an easy and convenient adjustment of the hands on the dial, to which they can be fixed with the screw. To secure the hands in their adjusted position, there may be a number of notches in the dial, and the co-operating part of the nippers may have a head to engage in one of the notches. The interior end of the shaft F is furnished with a conical pivot O, and the other extremity is tapered, and runs through a stuffing-box so as to assure impermeability. The ball-valve P rests on its seat by its own weight, and is lifted by the cam E when the shaft F revolves in the proper direction; other little balls Q then guiding the ball-valve P. A tube R, running to the pilot-light, is branched on the gas pipe, and is provided with a screw needle-valve S to regulate the tube.

The mechanism described works as follows: The two hands being adjusted on the dial to the time for ignition and extinction, the hand N will, at the specified time, impinge upon the finger I of the shaft F, to make the cam E turn so as to raise the ball P and allow gas to pass through the tube D to the burner, and ignite by contact with the pilot-light. The position of the parts with the valve open is shown in fig. 3. The burner continues alight, the cam E preserving the position given to it. At the time for extinguishing, the hand J will impinge with its catch K upon the fork balance-beam L, making the latter swing into the position shown in fig. 4, and bring, with the finger M, the cam E into its original place, allowing the valve to close and cut off the gas.

The other patent has been taken out by M. Louis Bardon, for a gas lighter and extinguisher, the special feature of which is rapidity of action produced by a to-and-fro motion of the key of a tap; the former being pierced with a single slit, which leads both to the pilot-light and the burner. The invention relates to a method of determining the time of ignition and extinction on the dial, as also the winding of the mechanism without touching the dial, and consequently without involving a new regulation of the instrument.

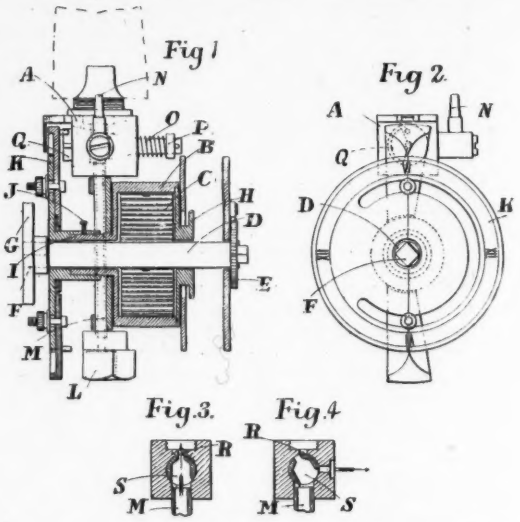






Fig. 1 is a vertical section of an igniter and extinguisher; fig. 2, a front view of the dial and regulating parts; and figs. 3 and 4, sections of the tap open and shut.

The instrument consists of a tap A, moved by suitable clockwork mechanism, comprising a barrel B, containing a spiral spring C, fixed by one end to the barrel-box and by the other to the shaft D, which has at one end a ratchet-wheel E and at the other a square piece F carrying a plug G. The clockwork is constructed as usual with a certain number of wheels operated by a lever escapement not shown. The main wheel H is cast on with the lid of the barrel. On the end of the latter is a sleeve I, on which slides a friction coupling furnished with a stop-screw J. This coupling forms one with the graduated dial K. On the coupling there are two loose rings, on which arms are fixed to regulate the time for ignition and extinction. The whole is supported by plates joined by cross-pieces.

The gas arrives through the hollow joint L, and runs through the pipe M to the tap. The latter consists of a shell having a conical space inside which a plug works. On the side of the shell there is a nozzle ending in a pilot-light N. The shell is pierced with three channels—a lower one through which the gas enters, a side one, communicating with the pilot-light, and an upper one leading to the burner. The plug, which consists of a truncated cone-shaped part and a cylindrical tail, is kept in place in the shell by a spiral spring O threaded on the tail, and resting for support on the shell and on a washer P mounted on the tail and secured by a pin. The front base of the truncated cone has a projecting cam Q in the form of the sector of a circle. The plug is pierced with a single diametrical channel S with a rectangular orifice at the top and a bell-shaped circular opening in the lower part. The object of this arrangement is to allow of communication being established between the lower and side channels and the bell-shaped orifice when the cock is shut. The cam is worked by two studs, which impinge on the cam on each side of its oscillating centre.

The working of the arrangement is as follows: The arms being moved opposite the proper divisions of the dial, and the mechanism being wound up (supposing the gas to be cut off), the pilot-light is lit; the channel S bringing the lower and side channels into communication. When the arm that works the igniter—*i.e.*, acting on the cam from below—comes into contact with the cam by rotation of the dial from right to left, the plug will turn in the direction of the hands, and the channel S will open the passage R, producing ignition of the burner, and the subsequent extinction of the pilot-light. After a certain time, the lower arm will impinge on the upper part of the cam, and make it rotate in the opposite direction. Owing to this movement, the channel S will cease to communicate with R, but its bell-shaped orifice will bring the lower and side channels into communication, and the pilot-light will ignite and the burner flame go out. Thus by regulating the position of the two arms on the dial, ignition and extinction

can be produced at the required time. For this purpose, the dial is divided into twenty-four hours. An indicator on the tap gives the present time.

As shown by the above description, there is complete independence between the dial, the regulating arms, and the winding mechanism. Moreover, considering the small sections for the passage of the gas for lighting, the action of the instrument is very rapid. In the trials which have been made of the instrument, it required only three minutes to obtain complete ignition and extinction.

## RECOVERY OF COAL-TAR OILS.

A process for separating the oils contained in crude coal tar has been devised by M. Auguste Carron, who has taken out for France a patent for it, the specification of which has recently been published. The patentee claims that it is economical, easily applied, and has the great advantage of yielding products which have no corrosive action on the receptacles containing them, or any injurious effect upon the workmen by whom they are handled. The characteristic feature of the process is the employment of crude oils (petroleum, turpentine, or similar oils) and ordinary commercial 30 per cent. chloride of lime, ordinary wood vinegar, and also sulphuric acid, diluted or otherwise, in quantities varying with the nature of the tar treated.

Coal tar varies in quality according to the kind of the coal from which it is obtained; and it may be divided into three classes—viz., very thick, inferior tar, semi-thick tar, and liquid tar of the best quality. The proportions of crude oils and calcium chloride to be employed in the process vary within the following limits: (1) For very thick tar, from 10 to 25 per cent. of crude oil must be added to and well mixed with it, hot or cold. The oil can then be separated in a few minutes by decantation. (2) About 0·25 to 1 per cent. by weight of the chloride is mixed for 20 minutes with the second quality of tar, and then about 10 to 25 per cent. of crude oil added. After mixing again, the oil can be separated in a few minutes. (3) For tar of the best quality, about 0·5 to 1·5 per cent. of ordinary 30 per cent. wood vinegar is added, and from 0·25 to 1 per cent. of the chloride. When these materials have been mixed for about 30 minutes, from 10 to 25 per cent. of crude oil is added, and left at rest. After mixing again, the oil can be quickly separated.

It has been found that if, in addition to the products specified, about 0·5 to 1 per cent. of ordinary commercial or other sulphuric acid is mixed with the tar, or sulphuric acid diluted with 1·5 to 4·5 per cent. of water or salt and water, separation of the oil is more rapid. The use of sulphuric acid decreases the proportion of the other products to be added, particularly that of the crude oil; the corrosive action of the acid being neutralized by the presence of water, calcium chloride, and vinegar.

When, after the treatment described, the oil is separated and removed, two other products are left in the decantation vessels: (1) A heavy, semi-solid substance or pitch, which can be utilized for roads, the making of compressed coal, or the manufacture of all kinds of damp-proof washes; and (2) a liquid, consisting of a mixture of creosote, carbonic acid, naphthalene, and similar substances, suitable for use as a disinfectant, and also as a saturating material to prevent humidity.

**Preventing a Water Famine in New York City.**—In order to avoid the possibility of another water famine being experienced, such as prevailed in New York City in the summer of last year, there has been constructed at Croton Lake what is termed a "blow-off." According to some particulars given in the Engineering Supplement to "The Times," it is a tunnel connecting with the new aqueduct above the lake itself, so that the latter will be kept full of fresh water which will be carried to the city by the old aqueduct. When the new one is completed below Croton Lake, the "blow-off," the velocity of the flow of water in which will be 75 feet per second, will not be needed except in case of emergency. But the new system, with its daily supply of 500 million gallons, cannot be put into service until after next year. The blow-off and the syphon under Croton Lake, which have just been handed over to the Water Department of the City, have been four years under construction, and cost $1,000,000.

**The Mantle-Tax in Germany.**—The official report on the revenue for the twelve months to March 31 of last year derived from the tax on gas-mantles, electric lamps, and other lighting agents in Germany, has been recently issued, and shows that the amount collected for the period was only 14·58 million marks [about £729,000], whereas the official estimate was for an annual revenue of 23 million marks. The "Journal für Gasbeleuchtung" points out that this deficiency of 36·6 per cent. on the estimated yield of the tax is an indication of its unsatisfactory character. It is contended that the tax has hindered the displacement of petroleum oil in small households by supplies of electricity and gas from public works, and that it has tended to force the manufacture of mantles, &c., into the hands of fewer firms. The number of factories producing mantles, glow lamps, &c., has diminished since the introduction of the tax in 1909 from 175 to 166. The tax is regarded as a fiasco, both in respect of its financial results and its social and industrial bearings.

# REGISTER OF PATENTS.

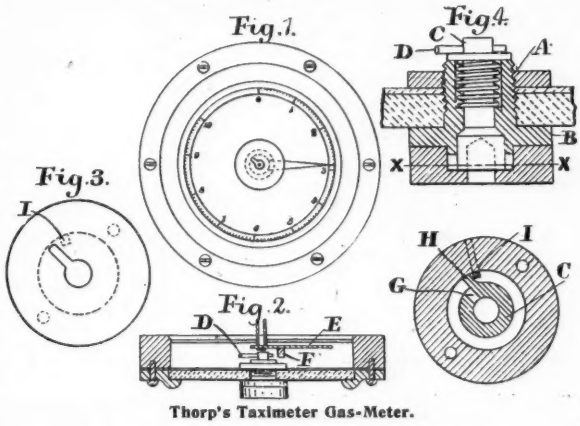
### Indicating Mechanism of Gas-Meters.

THORP, T., F., & H. T., of Whitefield, near Manchester.

No. 25,008; Nov. 10, 1911.

This invention relates to small gas-meters, "chiefly intended for use in hotels, lodging houses, and offices where the whole building is supplied with gas through an ordinary meter and the cost of the total commodity consumed is charged to the proprietor—the different occupiers of the rooms in the building being charged separately by the proprietor for the respective quantities consumed, which are measured by separate small retailing meters and charged weekly or monthly to the occupiers."

According to the present invention, such retailing meters are provided with a dial so graduated that a pointer connected with the registering mechanism will show only the cash value of the commodity passed through the meter, in combination with mechanism operated (from the outside) by means of a key in the possession of the seller, by means of which the pointer, the spindle of which is frictionally connected with the indicating mechanism of the meter—like the minute hand of a clock—can be set back to zero but cannot be moved forward. The setting mechanism is preferably arranged in a metal boss fitted into the glass cover through which the pointer can be seen, directly above the centre of the dial. By these arrangements, the patentees point out, not only all trouble or errors in calculating the value of the commodity are obviated, but tampering with the indications by the vendor setting the pointer forward is rendered impossible, while tampering by the consumer by setting it back by means of a false key can be prevented by placing an adhesive wafer over the keyhole, perforation of which would at once be evidence of tampering.




**Thorp's Taximeter Gas-Meter.**

Fig. 1 is a plan of the dial case, and fig. 2 a vertical section. Fig. 3 is a plan of the central metal boss fixed to the glass. Fig. 4 is a vertical section of it, and a horizontal section on line X.

The central boss is constructed as follows: A centrally drilled bush A, having a flange B, is secured in the centre of the transparent cover, which, in the case of a gas-meter, consists of a sheet of mica and a glass plate. In the bore of the bush a spindle C is supported, which projects past the nut securing the bush, and has fixed in it a pin D. On the pointer E a short central web F is fixed, which is encountered by the pin D when it is turned round. The front end of the spindle is enlarged and has a central sinking or recess at the front, and a slot G and (at the side of the slot) a lateral projection H, or an equivalent stud. The spindle C and flange B are covered by a recessed disc, fixed to the flange by countersunk screws put in from the back of the flange. In the recess of the disc (or in the flange), a stop peg I is fixed; and the disc has a central hole and a slot for the insertion of the key.

To set the pointer back to zero the key is turned (contra clockwise) till it encounters the stop peg I. During this movement the spindle is turned, and the pin D encounters the web F on the pointer E, and turns it back to zero. To remove the key, it is turned (clockwise) round till the projection H on the spindle encounters the stop peg I, and when the slots coincide the key can be withdrawn. The pin D is thereby also turned back out of the way of the pointer, so that the pointer can move freely up to the position determined by the peg. The peg also stops the spindle from being turned in a clockwise direction, and so prevents the pin D from turning the pointer forward. To prevent the weight of the pin from turning the spindle from this position under the effect of vibrations to which the meter is exposed, a spring may be inserted into the enlarged bore of the bush pressing against a washer above, and thereby pulling the shoulder of the spindle against its seating in the bush—the friction between the parts holding the pin safely in position and making a gas-tight joint.

The arc described by the pointer from zero till it is stopped by the pin is "graduated to indicate the value in shillings and pence somewhat in excess of the maximum value of the commodity that can be consumed during the intervals when the indications are read off and charged to the consumers"—for instance, 10s., as shown in fig. 1.

### Gas-Scrubber.

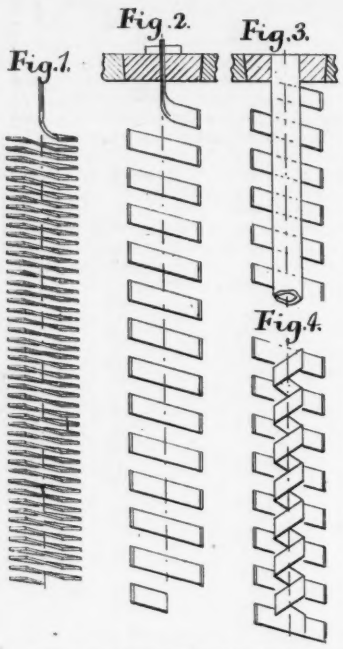
DAVIDSON, W. B., of Birmingham, and LIVERSEDGE, A. J., of Croydon.

No. 26,979; Dec 2, 1911.

This apparatus is of the class used to remove from gas substances suspended or contained in it, and particularly tarry matters, by causing the gas in its passage through the apparatus to be rubbed, more or less,

against the edges and surfaces of solid material, which may be moistened by water caused to trickle down over them.

Various substances, the patentees point out, have been used for the purpose named—such as pieces of coke, broken brick, tiles, pieces of wood, sawdust, sand, and the like. But a serious objection to the use of many such materials is their liability to become quickly choked by tarry matter or dust withdrawn from the gas. "The material thus deposited tends to retard the passage of the gas, and is difficult to remove without considerable labour and expense." In their scrubber, the rubbing surfaces are constructed in the form of open sharp-edged spirals made from strips or bars of iron or other suitable material, of any convenient diameter or length, and of any convenient thickness of material. "Their advantage lies in the fact that they may be made to present a very large surface and very great length of edge, against which the gas may be rubbed or scrubbed, with much less liability to become fouled or choked than is the case with other materials."




**Davidson and Liversedge's Fillings for Gas-Scrubbers.**

Several forms of spirals suitable for the purposes in view are illustrated. Fig. 1 is a spiral formed of a thin strip of metal having the surface of the strip at right angles to the axis of the spiral. Fig. 2 is a spiral having its surface parallel with the axis. In fig. 3 is shown a spiral having a core formed of a tube introduced for the purpose of still further breaking-up the gas in its passage across the spiral; but, instead of a tube, a solid bar of any convenient section may be used. In fig. 4 is shown a double spiral—that is, one spiral within another.

The spirals can be disposed in a variety of ways "in any suitable vessel through which gas is caused to pass." For example, they may be suspended from a plate forming the top of a chamber, as indicated in figs. 2 and 3, and in such manner that the gas must pass across them in a more or less tortuous manner, or they may be screwed into the base of such a chamber, or into the sides, or into inclined plates placed in such a chamber, or otherwise fixed into a pipe radially or transversely, or a combination of such arrangements. Alternately, the spirals may be piled in stacks in a suitable chamber, either systematically or in an indiscriminate mass, or arranged so that the gas may pass through the centres of the spirals axially, as well as outside of them.

## Gas-Lighting Appliances.

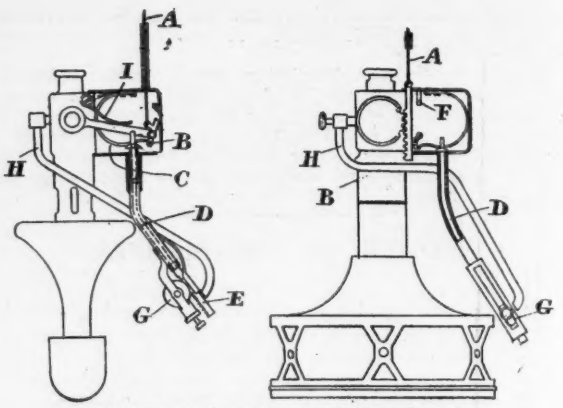
ANDERSON, H., of Manchester.

No. 5062; Feb. 29, 1912.

This invention relates to mechanism for lighting gas in which by the pulling of a cord the gas is turned on, while immediately afterwards (and by the same action) a mechanical sparking device and flash bye-pass ignite the mixture of gas and air. On the cord being released, the mechanism is restored to its former condition ready for again turning on and lighting the gas. It is an improvement on patent No. 10,285 of 1911 by utilizing the motion of a tap to set a spring in tension which, when released, will set in motion a mechanical sparking device—this motion being either of the continuous kind or in the nature of a shock due to a blow. Other features of the invention consist in the means employed for actuating a flash bye-pass from the gas-tap; the use of flexible wire tubing to guide the cord; and an improved switch or lever for actuating the cord.

The illustration shows the essential parts of an inverted incandescent burner fitted with the mechanism for turning on the gas and lighting it, and how the sparking device, which, in this case, can move backwards and forwards against the resistance of a light spring, can be struck and forced suddenly outwards by the released spring.

The gas-tap is operated by pulling the cord A, which works in a flexible tube consisting of a closely wound spiral wire—the pull being given by a switch lever pivoted to the bracket. The other end of the cord passes out of the tubing through a hole in the bracket, and is attached to the pivoted lever by the hook B. This lever is on the end of the tap lever, so that when the cord is pulled there is sufficient leverage to give the




**Anderson's Appliance for Lighting Gas-Burners.**

hook a purchase on the end of the spring C with which it engages. To the head of the flexible rod D is attached a loop embracing the spring C, by means of which the rod which operates the ratchet E and ratchet-wheel is drawn back, and at the same time sufficient distance is maintained between the head and spring to give the latter a striking force. When the tap is nearly open, the free end of the hook B comes in contact with the release tappet F on the bracket and releases the spring C, which strikes smartly the head of the rod D, on the other end of which is the ratchet E, which actuates the ratchet-wheel. The teeth of both are inclined so that they will only engage when operated in one direction; the acting faces being so placed that when the spring C is released and strikes the head of the flexible rod D they engage, and the file-wheel G is rotated sharply against a pin of cerium iron, producing a spark.

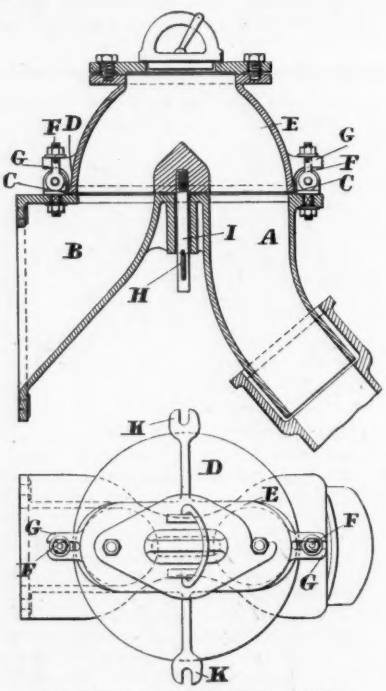
In the operation of turning on the gas, the gas also enters the bye-pass passage H through the body of the tap immediately the gas-barrel rotates, by means of the channels cut for the purpose at each end of the gas-way in the barrel. The exit end of the bye-pass tube is adjacent to the sparking arrangement, and the jet of gas emitted impinges on the sparking point, and, when lighted, flashes in the vicinity of the nozzle of the burner—the flash being of sufficient length to ignite the lamp. Immediately the gas is turned fully on, the bye-pass is extinguished; the gas connection thereto being cut off. The spring I, when the switch lever is released, brings the tap lever back again to the position it was in at first; thus turning off the gas, while at the same time the hook B again engages with the end of the spring C. When the ratchet E is being withdrawn during the operation of turning on the gas, by reason of the bevelled faces of the teeth on the wheel and ratchet E, they pass each other without the wheel rotating—it being held by a spring guide.

## Valve for Closing Gas-Pipes.

DUCKHAM, A. M'D., of Ashtead, Surrey.

No. 15,470; July 2, 1912.

In his specification, the patentee says: Valves for closing pipes for the passage of gases containing tar or the like are apt to give much




**Duckham's Vertical Retort Tar Valve.**

trouble—particularly when not very frequently used—owing to accumulations of tar, which cause the valve to stick, and prevent it from closing

properly. The valve constructed according to my invention for overcoming this trouble consists of a plate or cover held against the ends of two pipes constituting parts of the passage for the gas, and carrying an arched pipe which serves to connect the bores of the two pipes, and is substantially of the same bore as the two pipes connected.

In the construction shown, the valve is for the purpose of cutting off communication between a vertical gas-retort and its foul-main or tar-pot. The pipe A, leading from the retort, and the pipe B, leading to the tar-pot, form a single casting with their ends in the same plane. The end face of each pipe has an annular facing strip C, on which rests a carefully machined circular plate D, having two circular openings adapted to register with the ends of the pipes A and B, and being themselves the openings of a curved pipe E cast in one piece with the plate D.

In the position shown, the valve is open and is gas-tight, owing to the fact that wing-bolts F are engaged in the slots in the lugs G on the pipe E, and their nuts screwed home, and that the wedge-shaped cottar H has been driven home in its slot in the pin I. When the valve is to be closed, these fastenings are loosened, and by torque applied to the lugs G the plate D is turned about the axis of the pin I to bring unpierced portions of the plate D over the ends of pipes A and B, whereupon the bolts F are engaged in the lugs K, and the cottar H is driven home again to tighten the valve in its closed position.

Since the closing surface of the plate D is always accessible when the valve is open, it can easily be kept in a condition suitable for closing the pipes A and B when the valve is shut.

# CORRESPONDENCE.

*[We are not responsible for opinions expressed by Correspondents.]*

## The Koppers Chamber Ovens at Vienna.

SIR,—The letter of "J. T. S.," in your last issue, p. 450, calls attention to a discrepancy which may be observed in many instances between the calorific power of gas as determined by the calorimeter, and as calculated from an analysis of the gas.

In the case cited by your correspondent, the discrepancy is certainly greater than usual. It may be partly accounted for by the calorific value of the heavy hydrocarbons having been taken by "J. T. S." as equivalent to that of propylene. I have found that the figure of 670 calories, or 2658 B.Th.U., per cubic foot, given in the 1896 and 1898 editions of my text-book on "Gas Manufacture," for the mean gross calorific power of the mixed hydrocarbons in coal gas, usually brings the calculated calorific power of the gas more nearly into line with the observed calorific power than if the calorific power of propylene is taken to apply to the whole of the heavy hydrocarbons. But even if the figure which I prefer is adopted for the comparison made by "J. T. S.," the calculated calorific power of the gas works out at a little under 560 B.Th.U. per cubic foot, compared with 612 B.Th.U. for the observed calorific power.

The discrepancy suggests that the analysis of the gas in this instance may have been untrustworthy. It is perhaps, however, worth while pointing out that the specific gravity—viz., ·431—given for the gas corresponds fairly with the analysis if the bulk of the heavy hydrocarbons is assumed to have the specific gravity of benzene. If it is inferred thence that they are mostly benzene, and the calorific power of benzene is introduced in calculating the calorific power of the gas, the latter becomes nearly 590 B.Th.U. per cubic foot. Even so, the observed calorific power is still some 22 B.Th.U. per cubic foot higher than the analysis would lead one to expect. Generally speaking, one prefers to take an observed to a calculated calorific power, because the error in the determination of the calorific power of gas with a good calorimeter is of a lower order than the errors in an ordinary technical analysis of coal gas..

W. J. A. BUTTERFIELD.

*Victoria Street, S.W., Nov. 6, 1912.*

SIR,—The "discrepancy" in the figures shown in the table accompanying the description of the Vienna Gas-Works, published in the "JOURNAL" for the 22nd ult., is only apparent. The calorific value of the gas was measured by a Junkers recording calorimeter, and was checked periodically by an ordinary calorimeter. The average value so obtained was 612 B.Th.U. gross.

In calculating the value from the analysis of the gas, your correspondent "J. T. S." has omitted to take account of the fact that the values obtained by using Coste's figures are for gas at 0° C., whereas the registered figure is at 15° C. The correcting factor for this temperature is 1·073; and on applying this factor to the calculated gross value at 0° C., your correspondent will find that the calculated and actual values agree very closely.

I might add that the table of results published is a copy of the official table, accepted and signed as correct by the Vienna authorities, who would undoubtedly have perceived any discrepancy, had any existed.

G. STANLEY COOPER.

*Nov. 7, 1912.*

## Electric Ignition of Gas.

SIR,—in your issue of Nov. 5, p. 463, we find a news paragraph headed "Electric Ignition of Gas," which refers to an accident caused by the short-circuiting of electric light wires on a gas pendant. The title is, in our opinion, very misleading, and might cause people to believe that it refers to a system of electric ignition of gas; and as ours is practically the only system of electric ignition in general use, your paragraph is more likely to injure us than anyone else.

We may point out that the very slight current used to operate our apparatus is incapable—if short-circuited—of igniting gas in the manner described in the paragraph. The voltage used for electric lighting is altogether a different thing from the small voltage produced by the dry cells operating the "Telephos" gas-switch.

TELEPHOS LIGHTING COMPANY, LIMITED.
J. T. BOND, Manager.

*Farringdon Avenue, E.C., Nov. 7, 1912.*

## The 1879 Improved Lighting of the Waterloo Road.

SIR,—In the article in the "JOURNAL" for Oct. 29, I am afraid I did not do justice to one now since departed, when I referred to the experimental gas lighting in the Waterloo Road, Lambeth, in 1878-79, under Mr. Corbet Woodall, the then Engineer of the Phœnix Gas Company.

I refer to one whose memory we all honour—the late Mr. William Sugg (who did so much for the gas industry), and who was also interested in, and largely responsible for, the ultimate success of the installation mentioned; he being the inventor and maker of the gas lanterns used, and the steatite burner specially designed for the experiment.

I am also reminded of this fact by one who remembers the circumstance, and who says: "You quote from the 'Daily News,' but why leave out 'Punch,' who said on the 15th of February, 1879: 'The real modern Aladdin's magician is Mr. Sugg, who, by means of his improved burner, gives us, "new lamps for old ones." See the Waterloo Road and Waterloo Place *passim*. "*O si sic omnia*"? If all gas-light were like these, who would ask for Edison and electricity?'"

THE WRITER OF THE ARTICLE.

*Nov. 8, 1912.*

## The Working of Vertical Retorts.

SIR,—In the discussion on Dr. Davidson's paper on "Carbonization in Horizontal and Vertical Retorts," Mr. J. Ferguson Bell says, in respect to Dessau verticals, that "this [the acceleration of the charge of coal], together with the superincumbent weight of coal, resulted in a pressure of 6 inches or thereabouts upon the bottom of the retort after charging."

Might I be allowed to point out that this is not the case with all the installations of Dessau verticals. In the paper which I had the privilege of laying before the North of England Association at their meeting held at Newcastle-on-Tyne on May 4 last, a chart was given of the pressures at the bottom mouthpieces of the Dessau verticals in use at East Hull, which only showed a maximum pressure of 2 inches, and this only obtained for a short time of the total duration of the charge. Continued working experience from that date has proved this to be the case invariably.

Momentum (being the quantity of motion possessed by a body) is the product of its mass and its velocity; so that the density of the charge at the bottom of a vertical retort—intermittently charged—is proportionate to the mass liberated per second, or to the time occupied in charging. This time, of course, must not, for obvious reasons, be unduly prolonged; but it is certainly a factor in the placing of the charge and the resulting gas pressure at the bottom mouthpiece immediately after charging. It also follows that with a charge thus lightly (comparatively) laid in a vertical retort, not only must the gas pressure be reduced, but the coke made must also be less dense than with a charge laid as referred to by Mr. Bell. This we have also proved by experience to be the case.

RD. NELSON.

*East Hull Gas Company, Nov. 6, 1912.*

# PARLIAMENTARY INTELLIGENCE.

## JOINT COMMITTEE ON GAS RESIDUAL PRODUCTS.

Last Wednesday, a message was received by the House of Lords to the effect that the House of Commons had appointed a Select Committee of five members to join with a Committee of the Upper House to consider the question of gas residual products; and a request was made for the nomination of an equal number of lords. The message was duly considered, and the following were named: The Earl of Craven, Lord Braye, Lord Howard de Walden, Lord Plunket, and Lord Inchcape. A message was sent to the Commons to inform them of the appointment of the Committee, and to propose that the Joint Committee should meet in Room A on the 12th inst (to-day). This message, so far as it related to the place and time of meeting of the Joint Committee, was, on its reception, considered by the House of Commons, and agreed to. The full Committee consists of the above-named members of the Lords and the following members of the House of Commons (whose names were given last week): Mr. Hills, Mr. Lardner, Mr. Walter Rea, Mr. Samuel Roberts, and Mr. George Thorne. The Committee have the usual power to "send for persons, papers, and records, and to hear parties interested, by themselves, their Counsel, Agents, and witnesses, if they think fit."

### Thefts from Prepayment Gas-Meters.

Mr. Joynson-Hicks had on the paper last Thursday two questions on this subject, addressed to the Secretary of State for the Home Department. By the first he was asked if he would state the result of the conference he promised on the 10th of June last, between his Department and the gas companies, in reference to thefts from prepayment gas-meters; whether he was aware that such meters were continually and increasingly being fixed in the homes of poor people; and whether the number of cases of theft from them was increasing in an equal ratio. The second question was whether the Home Secretary was aware that in the agreements between the gas companies and the consumers in regard to prepayment meters the consumer is bound to make good the amount of money which might be stolen from the meter-box, although such theft was committed by a burglar or other person entirely unconnected with the tenant; whether he was aware

that upwards of 13,000 of such robberies took place last year; and what steps he proposed to take in the matter.

The two questions were answered together by Mr. Ellis Griffith as follows: "A conference on the subject was held on the 4th of July between the Home Office and representatives of the London Gas Companies. The main result of the discussion was to make it clear that these larcenies are facilitated by the use of flimsy boxes, and that they can be checked by providing the meters with boxes of stronger construction and fitted with better locks. A new form of box, of much stronger construction than that generally in use, has recently been adopted by one or two companies with good results; and all the companies have now agreed that stronger boxes shall be gradually introduced in those districts in which the larcenies chiefly take place. Another conclusion reached at the conference was that the meter should be so placed as not to be readily accessible to any person save the occupier and his family; and the companies have accepted a rule that, in the case of tenement buildings and houses let in lodgings, the meter shall, whenever possible, be placed inside the tenement or room. The companies have also undertaken to bear in mind the importance of making frequent collections in the districts where the larcenies mostly occur. The Secretary of State trusts that this agreement, which has been arrived at after full consideration of the whole question, will result in a large reduction in the number of larcenies. The obligation of the consumer to make good any deficiency in the meter-box is regarded by the companies as necessary for the prevention of crime; but they say that the rule is, and will be, enforced with discretion in individual cases.

# LEGAL INTELLIGENCE.

## RATING OF LICENSED PREMISES FOR WATER SUPPLY.

### HOUSE OF LORDS—Nov. 4 and 5.

(*Before the* LORD CHANCELLOR *and Lords* ATKINSON, SHAW, *and* MERSEY.)

Their Lordships were engaged last week hearing arguments in an appeal by the Metropolitan Water Board against an order of the majority of the Court of Appeal (Lords Justices Farwell and Kennedy—the Master of the Rolls dissenting) in favour of the respondent, Mr. Raphael Phillips, the occupier of licensed premises known as the "Brown Bear Inn," Aldersgate Street, City.

Mr. BALFOUR BROWNE, K.C., Mr. MARK ROMER, K.C., and Mr. JOSHUA GOODLAND (instructed by Mr. Walter Moon, Solicitor to the Water Board) appeared in support of the appeal; Mr. RYDE, K.C., and Mr. KONSTAM (instructed by Messrs. Maitlands) were for the respondent.

The appeal arose out of an action brought in the Chancery Division by the present appellants to have it declared that (1) on the true construction of the Metropolitan Water Board (Charges) Act, 1907, the water-rate of the "Brown Bear" for the quarter from Oct. 1 to Dec. 31, 1910, ought to be calculated upon the rateable value of £400, as being the rateable value thereof according to the valuation list in force at the commencement of the quarter, and (2) payment of £5, being at the rate of £5 per cent. per annum upon the rateable value of £400 for the quarter above mentioned, and of £2 18s. 6d. being at the same rate, but upon a since made provisional assessment for the quarter from Jan. 1 to March 31, 1911.

The defendant contended that the rate for both quarters should be £2 18s. 6d.

The liability of the defendant to pay £5 for the quarter between Oct. 1 and Dec. 31, was regarded by the Licensed Victuallers' Central Protection Society of London as involving a question of general importance to the trade, and they took up the case, which was, therefore, fought on both sides as a test case.

The question of liability turned on the construction to be put on section 13 of the Metropolis Charges Act of 1907, which enacts that "the rateable value of any house or building, or part of a house or building, for the purposes of this Act shall be determined by the valuation list in force at the commencement of the quarter for which the rate accrues, or (if there is no such list in force) by the last rate made for the relief of the poor or other rate in which the last-mentioned rate is included." By section 70 of the Water-Works Clauses Act, 1847 (which was incorporated with the Charges Act), it was provided that water-rates should be paid in advance by equal quarterly payments in England, and there was a provision in the Charges Act that, notwithstanding this enactment in section 70 of the Act of 1847, the quarterly days for payment of water-rates to the Board should be not the usual quarter-days, but the first day of April, July, October, and January in each year.

In 1908, the valuation list then in force in the City was altered by the making of a supplemental valuation list, in which the rateable value of the defendant's premises was shown at £400; and the list came into operation on April 6, 1909. It was upon this list that the plaintiffs contended that the water-rate for the quarter from Oct. 1 to Dec. 31, 1910, was to be calculated. Owing to the operation of the Finance Act, the value of the defendant's premises (like all other licensed property in the City) fell seriously in value; and he claimed to have the assessment reduced. On June 2, 1910, the Overseers sent to the Assessment Committee, as required by section 47 of the Valuation (Metropolis) Act, 1869, a provisional list in which the defendant's hereditaments were included at the reduced rateable value of £399; and on June 23 the Clerk of the Assessment Committee served upon the defendant a copy of so much of the provisional list as related to his premises. The defendant considered the suggested reduction insufficient and appealed. On Oct. 3, the matter was considered by the Assessment Committee; and they reduced the assessment from £399 to £234, returning the list to the Overseers duly dated and signed by their Clerk.

The question then arose, as the rate for the quarter Oct. 1 to Dec. 31 became due and payable in advance on Oct. 1, and the provisional list, although sent by the Overseers to the Assessment Committee in June, was not dealt with by the Committee until Oct. 3, whether the valuation of the defendant's premises—which by section 13 of the Charges Act, 1907, was to be "determined by the valuation list in force at the commencement of the quarter"—was that which appeared in the original valuation list at the figure £400 or in the provisional list at the figure £234.

As the parties were not able to agree, the present proceedings were instituted.

The action came on for hearing before Mr. Justice Parker;* and on behalf of the plaintiffs it was contended that the provisional list formed no part of the valuation list for the time being in force, as its effect was future and not retrospective. For defendant, the contrary was argued. The learned Judge held that the valuation list referred to in section 13 (1) of the Charges Act was the original list in existence on the first day of the quarter for which the water-rate accrued, unaltered by any provisional list unless such provisional list had then been completed after any objection thereto had been taken before and determined on by the Assessment Committee. In other words, he held that as the Committee had not determined the objection against the valuation until Oct. 3—*i.e.*, three days after the rate became payable on demand in advance—the valuation of £400 was the valuation in force for that quarter of the premises. Accordingly, judgment was given for the Water Board with costs. From this, defendant appealed.†

The Court of Appeal, by a majority, reversed the decision of Mr. Justice Parker. Lords Justices Farwell and Kennedy were of opinion that the valuation list referred to in section 13 (1) of the Charges Act was the list really and legally in force on the first day of the quarter for which the water-rate accrued—that is, the original list as altered—although subsequently to the first day of the quarter—by any provisional list made in accordance with section 47 of the Valuation (Metropolis) Act, 1869. The Master of the Rolls considered that the view taken by Mr. Justice Parker was correct; and he dissented from the other members of the Court.

It was, therefore, on this equally divided judicial opinion—Mr. Justice Parker and the Master of the Rolls one way, and Lords Justices Farwell and Kennedy the other—that the House of Lords were asked to decide the question.

The argument of the respondent's Counsel turned entirely on sections of various Acts mostly dealing with the poor rate, cited and discussed with a view to showing that, if the dispute had been in reference to a claim for poor rate, the order of the majority of the Court of Appeal was right, and should be affirmed and the appeal dismissed.

Replying for the appellants,

Mr. BALFOUR BROWNE characterized Mr. Ryde's argument as an invitation to their Lordships to "wade" through a very great deal of learned argument, in order that they might be able to understand properly a small point on which the decision of the case really turned. He submitted that much of Mr. Ryde's argument was outside the real issue. What had their Lordships to do with the provisions of the Water-Works Clauses Act, 1847, and now obsolete provisions under the Union Assesment Committee Act, 1862, as to how the poor rate was to be assessed? He admitted that under the older Acts there were various difficulties, and that their provisions were ambiguous. But all ambiguity was swept away as to how and when the rate was to be ascertained on which the charges were to be based for water supplied to premises by the simple statement in section 13 (1) of the Charges Act, 1907—the only section the House had really to consider and construe—which explicitly said "the rateable premises for the purposes of this Act shall be determined by the valuation list in force at the commencement of the quarter for which the water-rate accrues." If these words were given their simple meaning, then all difficulties vanished. The much-discussed sub-sections 8, 9, and 10 of section 47 of the Valuation (Metropolis) Act, 1869, needed no ingenious argument by Mr. Ryde to explain and fit in with the meaning he desired to put upon the simple words of section 13. All was intelligible. All changes in the supplemental or provisional list, whether up or down, were future and not retrospective, relative to the list in force at the commencement of the quarter for which the water-rate accrued. He submitted that the judgment of Mr. Justice Parker should be restored.

The LORD CHANCELLOR said the House would take time for the consideration of their judgment.

* See "JOURNAL," Vol. CXVI., p. 923.
† See "JOURNAL," Vol. CXIX., p. 205.

## KENT COUNTY GAS COMPANY, LIMITED.

### Preference Shareholders and the Company's Secret Profits.

In the Chancery Division of the High Court of Justice last Tuesday, Mr. Justice Neville delivered the following considered judgment in an application made by the Liquidator of the Kent County Gas Company, Limited, under the circumstances set forth in the "JOURNAL" for the 29th ult. (p. 380).

Messrs. F. C. Lawson and Co., in which firm Darby and Gyde were the only partners, were the vendors to the Company of their business, and were also promoters. They made an undisclosed profit out of the sale to the Company—being thereby guilty of a misfeasance in the nature of a breach of trust. Both Darby and Gyde were bankrupt, and their estates are represented by the Official Receiver. The receiving orders against them were made at different dates and on different petitions. Against the estate of Darby a proof by the Liquidator of the Company for £14,063 has been admitted in respect of this misfeasance, upon which a dividend of £2304 has been paid, which permits of a payment to the shareholders on account of their shares. Two of the shareholders who would participate in the dividend—Reynolds and Norris—are admittedly nominees of Lawson and Co. They have been served with the summons and do not appear. The Liquidator claims to withhold payment of the dividend upon their shares till the liability of Lawson and Co. to the Company is satisfied. This claim raises several questions, one of which is whether, under the circumstances,

the indebtedness resulting from the misfeasance of the firm arises out of a distinct contract within the meaning of Rule 18 in the second schedule to the Bankruptcy Act of 1883, so as to entitle the Company to prove against both the joint and separate estates of the partners. If the liability is within the rule, then the creditor has a right to prove against both estates; but if not, then it is said that, though the liability of the partners be joint and several, this gives the creditor only a right of action and not a right of double proof. Being in respect of a breach of trust, that the liability is joint and several I entertain no doubt; and if the dictum of Mr. Justice Cave *in re Parker* is correctly reported and correct, this would bring it within Rule 18. But I think that the dictum is not correct. In "Lindley on Partnership," the learned author says: "If a firm has been implicated in a breach of trust, the *cestui que* trust (who thereby assigns a right against all the partners jointly as well as against each of them separately) cannot prove against the joint and separate estates at the same time, but must elect against which he will prove as if he were an ordinary joint and separate creditor." Dealing with Rule 18, Schedule II. of the Bankruptcy Act, 1883, says: "All fraudulent breaches of trust are not within the Act; but if a partner who is a trustee improperly lends trust money to the firm, the *cestui que* trust can prove against the separate estate and against the joint estate of the firm, for such a case is within the Act." Citing the Parker case as the authority for this proposition, this decision was approved by the Court of Appeal, *in re P. Macfadyen;* and the principle was applied to the case of a director who was guilty of a breach of trust in misapplying the property of the company for the benefit of his firm—a proof against his separate estate being allowed, as well as proof against the firm where the several liability arises out of a distinct contract, as where an express trustee joins with other members of his firm in misapplying moneys belonging to his trust, in which case he is liable as a partner for the breach of the implied trust, and as trustee on the breach of the express trust. The case appears to me to be distinguishable from the case of misapplication of a trust fund by a firm of which no member is an express trustee, which is the present case. It appears to me that the only breach of contract was committed by the firm when they made the secret profit, having put themselves in a fiduciary relation to the Company. In such a case, I think Rule 18 does not apply. It follows, in my opinion, that the Company are put to their election whether to pursue their remedies against the joint or the separate estate; and that, having proved against the separate estate of one of the partners, they are precluded from proceeding against the joint estate unless they withdraw their proof, which is impossible in the present case, inasmuch as the dividends in question are the fruit of the proof itself. I am of opinion, therefore, that no liability on the part of the firm now exists, and that, assuming that a liquidator is entitled to retain dividends payable to shareholders who hold their shares as bare trustees until a liability of their *cestui que* trust is satisfied, there is in the present case no liability on the part of Lawson and Co., whose nominees the shareholders in question are admitted to be. The claim of the Liquidator therefore fails, and the summons must be dismissed; the costs of the Liquidator and of the Official Receiver to be paid and retained out of the assets of the Company.

## CLAIM AGAINST THE WANDSWORTH GAS COMPANY.

### Alleged Negligence by a Gas-Fitter.

At the Wandsworth County Court last Tuesday, before his Honour Judge HARINGTON, an action for damages was brought against the Wandsworth and Putney Gas Company by Mr. and Mrs. James Roots, of Malva Road, Wandsworth, in respect of illness caused through the alleged negligence of the Company in allowing gas to escape from a disused pipe in premises rented by the plaintiffs.

Mr. MARTIN O'CONNOR appeared for the plaintiffs; and Mr. CROMPTON SMITH represented the Company.

Mr. O'CONNOR, outlining the case, said the plaintiffs took a house in April last, and Mrs. Roots went to the Company to have the gas laid on. There were some gas-pipes on the premises, and also a meter. She subsequently signed a form for the gas to be supplied on the prepayment system in other parts of the house. The previous tenant had used gas, but the supply had been disconnected; and instead of the pipe being sealed, the end was simply twisted. One morning, Mrs. Roots found her husband in a deep sleep. A doctor was sent for, who said there was an escape of gas; and he found it coming from the twisted pipe. This had been going on from April 26 to May 3. When the Company's representative arrived, and found the gas escaping, Mr. Roots was in a bad condition. He was subsequently sent to the Infirmary, where he remained for some time. Gas poisoning had entered his blood, which was very much impaired, as he was rheumatic. Mr. O'Connor submitted that it was the duty of the Company to see that pipes did not leak.

*James Roots* stated that in the room in which he slept there was the end of a gas-pipe over the doorway. On the 3rd of May, he went to bed, and the following morning his throat was swollen and he felt very ill. A doctor was called in, and Mrs. Roots sent to the Gas Company. A man came and cut off the gas-pipe near the meter. He said the gas was escaping over the door. He (witness) was unable to go to work, and was under the doctor up to the 16th of May. On the 23rd he went into the Infirmary, where he remained until August. He had been attended by a doctor since. About six weeks ago, he went back to work; but he was unable to do much, and had to return home. Before the gas poisoning, he was a strong and healthy man; but now he had little use in his body.

Cross-examined by Mr. CROMPTON SMITH, plaintiff said he did not think the smell was due to the gas, but to fresh paint or size on the wall. He should not have thought a proper mechanic would have twisted a pipe in the way the one over the doorway was twisted. He did not tell the Gas Company that there was such a pipe on the wall, as he thought it was a dead one. Two-and-a-half years ago he had an illness which he thought was rheumatic fever; but it was muscular pains in his arms. His occupation of a riverside lighterman exposed him to risks of cold.

In reply to a question by his Honour, Mr. CROMPTON SMITH said his point on the cross-examination was that plaintiff was not suffering from gas poisoning.

Mrs. *Frazer*, a former tenant of the house, deposed that when the gas was disconnected, the pipe in the room mentioned was cut off and twisted round by the Gas Company's servants. She detected a smell of gas after it was cut off.

Dr. *M'Murtry* said he was called to see the plaintiff, who was suffering from an acute sore throat, headache, sickness, and prostration. He was in a weak condition, and almost pulseless; and in his (witness's) opinion, he was suffering from gas poisoning. There was a smell of gas in the room where plaintiff was sleeping on a bed underneath an open window; and witness believed the window saved the man's life, as the room was small. A gas-pipe was curled round above the door, and gas was escaping from it. Witness saw plaintiff on the 23rd of May, and advised his removal to the Infirmary.

In cross-examination, witness said plaintiff was treated in the Infirmary for rheumatic fever; but he could not say that this was a result of the gas poisoning.

Dr. *W. Rawson Brown* said he had had experience of a number of cases of gas poisoning. Plaintiff had a murmur at the heart, which had been accelerated by a fever. Gas poisoning would much reduce the heart's action.

Mrs. *Roots* gave evidence as to the position of the meter and to the condition of her husband when she went to wake him on the 3rd of May. She said she had also been in the Infirmary suffering from gas poisoning.

Cross-examined, witness stated that the only smell she had had to complain of from the time she entered the house until the 3rd of May was the smell of paint, &c. When the Gas Company's representative called, he told her husband that "it was a wonder the escape of gas hadn't killed him."

Mr. *Collinge*, a builder, said it was dangerous to leave a gas-pipe in the condition of the one in question.

Dr. *MacCormac*, the Medical Officer at Wandsworth Infirmary, stated that when Mrs. Roots was admitted she was said to be suffering from gas poisoning; but witness thought that it was a bilious attack. When she left, she told witness that she felt "nicely." There was absolutely nothing in her symptoms to indicate poisoning by gas. Mr. Roots (the plaintiff), when admitted, told witness that he had rheumatic fever two years ago. He was suffering from acute rheumatism. Witness saw no signs of gas poisoning, and thought there was no connection between it and the plaintiff's condition.

The further hearing of the case was adjourned.

## Heavy Losses on a Mantle Company.

At the London Bankruptcy Court last Tuesday, the first meeting of creditors was held under the failure of Frederick Edwin Bodkin. The statement of affairs filed by the debtor disclosed gross liabilities to unsecured creditors amounting to £2189, and to fully secured creditors £4735; the value of the securities being estimated at £5156. The assets were estimated to produce £1475; and the deficiency was returned at £414. The Official Receiver stated that in April, 1900—on the death of his father, William Peter Bodkin—debtor came into a fortune of between £25,000 and £30,000. About twelve months afterwards, his mother died; and he then became entitled to an eighth share of copyhold property in the Manors of Edgware and Belsize. In 1903 or 1904, he became a Director of the Hornsey Gas Company, and the holder of about £5000 worth of stock and shares in the Company. His fees as Director amounted to about £280 per annum. In 1909, he charged this security, together with other property, to a bank at Oxford, in respect of moneys advanced to the Cerofirm Mantle Company, Limited; and in October, 1911, the whole of the securities were sold by the bank. The sale of the Hornsey gas shares removed his qualification as a Director, and he had to resign. In 1907, he and others formed the Cerofirm Mantle Company, Limited, with registered offices at Oswaldestre House, Norfolk Street, Strand, with a capital of £120,000 in £1 shares. He became a Director of the Company, and was allotted (jointly with a Mr. Sibthorpe) £35,000 in shares for cash to be found by them, and £35,000 in shares jointly as commission. The Company was a failure; and after an existence of about eighteen months, it went into liquidation. He did not think there would be sufficient to pay the creditors of the Company. He estimated his loss on the Company at £15,000. There were now cross-actions pending to settle the liability of the various parties interested. He also lost £6000 in connection with the purchase of a patent from a Mr. Francis Barker. He alleged his failure to have been caused through losses in connection with the various companies in which he was interested, and to inability to handle his property to the best advantage, owing to the action of the mortgagees. The estate was left in the hands of the Official Receiver.

**Crawley and District Water Company.**—At the half-yearly general meeting of this Company held recently, the Directors reported that the water rentals and charges showed an increase, and the balance of revenue was £147, after defraying all working expenses and making allowance for depreciation. The new suction-gas plant had been installed, and was in perfect order; and the economies expected therefrom were showing themselves. The report was adopted without comment. In seconding a vote of thanks to the Directors, Mr. South said he thought, after fourteen years, the Company should be in a position to pay substantial dividends, whereas no dividend was forthcoming. The Chairman (Mr. C. J. Longley) said Mr. South was evidently unaware of the difficulties the Company had had to contend with. To get water, they had to bore down 930 feet—a depth which had created a record. The cost of boring was double what the engineers had estimated, and it was utterly impossible for them to have foreseen what they had to contend with. However, he assured Mr. South that as soon as possible—perhaps in another year or two—the Directors would be able to pay a dividend.

# MISCELLANEOUS NEWS.

## GAS REGULATION IN NEW SOUTH WALES.

### Comparison with English Legislation.

In the "JOURNAL" for the 15th ult. (p. 236), we gave some extracts from the addresses of Counsel to the New South Wales Legislative Assembly in opposition to the Bill introduced to regulate certain Gas Companies in New South Wales. The undertakings represented were the Australian Gaslight, North Shore, and Newcastle Companies; and it may be remembered that in the course of the address of Mr. Adrian Knox, K.C., who appeared for the first-named Company, he was interrupted by the Speaker at the point where he was comparing the proposed legislation with that which had been adopted in England. This intervention was greeted with cries of "Shame" from the Opposition; but, notwithstanding this expression of disapproval, Mr. Knox was not allowed to continue his argument. We have just received from the Secretary of the Company (Mr. R. J. Lukey) a pamphlet containing a verbatim report of the addresses, including the portion objected to; and it may be of interest to complete our record of the proceedings by reproducing the principal features of it.

The main points of difference between the Imperial legislation and the provisions of the present Bill may be summed up as follows:

(*a*) The Imperial Parliament has fixed as the standard price an amount considerably in excess of the price then actually charged—*e.g.*, 3s. 3d. against 2s. 8d. The Bill proposes to make the price now charged the standard price. The Commercial Gas Company, in the instance cited, might have raised the price of gas to 3s. 3d. if necessary to pay the 10 per cent. dividend; but if the [Australian] Gas Company raises the price above 3s. 9d., the dividend must be reduced below the miserable rate of 4 per cent.

(*b*) The Imperial Parliament, in substituting 4 per cent. for 10 per cent. as the standard dividend has, I believe, in every instance simultaneously increased the capital on which the dividend is payable to a corresponding extent—*e.g.*, has converted £100 of 10 per cent. stock into £250 of 4 per cent. stock; thus leaving the stock wholly in the same position as it occupied before. No such proposal is embodied in this Bill, the result of which would immediately be to deprive the shareholder of more than half his capital, and about three-quarters of his income. The method adopted by the Imperial Parliament has preserved to every stockholder the full capital value and the full income return of his investment. This Bill proposes to deprive the shareholder of considerably more than half of both. Moreover, it is instructive to notice that when the business of a gas company has been transferred to a local authority, the shareholders' interests have been preserved, and—in some cases, at any rate—they have been paid the amount expended out of profits in extension of works. Under these circumstances, it is impossible to contend that the Imperial Statutes afford any precedent for the provisions of this Bill.

Another fundamental difference between the Imperial legislation and these proposals arises from the fact that in England, as long ago as 1847, the dividend payable by gas companies was limited to 10 per cent. by the Gas-Works Clauses Act. At the time that this Act was passed, gas-works must have been comparatively few in number, and the amount of capital invested negligible in comparison with that now employed. Nevertheless, the Act was carefully limited to apply only to companies thereafter formed; and companies which did not originally come under its provisions have only been brought under similar provisions and restrictions on their application to Parliament for statutory powers. At the same time, it must be observed that in no single instance, so far as I have been able to discover, have the rights of stockholders in a company which had obtained statutory powers before 1847 been interfered with in any manner calculated to depreciate the value or earning power of their stock.

I now propose to deal in detail with the proposals contained in the sections of the Bill to which objection has been specially raised by the Company. The effect of clause 13 [as to the dividend] as it stands is to confiscate for the benefit of consumers money belonging to shareholders in the Company. To state it thus is to show without anything more that the provisions of the section are indefensible in principle, and so far from being warranted by precedent, I can find no single instance of an English Act in which any similar operation has been attempted. The uniform English practice has been, if the rate of dividend has been cut down, to increase proportionately the capital on which the dividend is payable; and the following, among other cases, afford instances of this: Commercial Company, South Metropolitan, Gaslight and Coke, Wandsworth and Putney, South Suburban, Bristol, &c. And it is noticeable that in some of these cases opposition to the proposals was offered by the local authority.

To prevent injustice to shareholders in the Company, it will be necessary to alter this clause, so as to preserve to the shareholders the capital value and income return of their shares as before the introduction of the Bill. This could be done by increasing the dividend-bearing capital of the Company to £1,275,000, and by altering the standard dividend to 10 per cent.

The increase of capital is amply warranted by the fact shown by the balance-sheet of the Company that, in addition to the £850,000 subscribed capital on which dividends have hitherto been paid, there is invested in the business the sum of upwards of half-a-million of money belonging to the shareholders, made up of the following items:

| | |
|---|---|
| Premium capital | £282,225 |
| Reserve fund | 110,450 |
| Reserve for replacement of meters | 18,257 |
| Portion of suspense account | 100,000 |

If these amounts had not been received or withheld from the shareholders, the capital must have been increased to provide for necessary extension of the business, and in that case such capital must have been regarded as dividend-bearing. If £425,000 of this amount were capitalized, the capital would stand at £1,275,000; and a dividend at the rate of 10 per cent. would amount to the same sum as in recent years has been paid in dividends, thus preserving the interests of the shareholders.

With regard to the rate of dividend, it is obvious that a limitation to 4 per cent., besides working grievous injustice to the shareholders, must render it impossible for the Company to obtain further capital when needed for extensions of their business; for it is impossible to suppose that investors will buy shares in the Company on which the dividend is limited to 4 per cent., having regard to the fact that at the present time Government stock can be purchased in the open market at a price which gives a return of 4¼ per cent. to the purchaser. It is doubtful whether the Government could itself borrow at less than from 4¼ to 4½ per cent. Moreover, the rate of dividend allowed in English legislation with regard to gas companies has been uniformly 10 per cent. on original capital, and this is recognized by the Model Gas Bill of 1910, which has been drawn upon for some of the provisions of the Bill now before Parliament for discussion, but apparently has been disregarded in this respect.

It is true that the standard dividend in the case of many gas companies in England is now 4 per cent.; but in every case where this is so the stock has been proportionately increased, so as to make the real return 10 per cent. on original capital. It is, of course recognized that the investor, in the case of new capital, buying into an established concern is not entitled to the same return as if he were an original subscriber; and consequently the English practice has been to provide that the standard rate of dividend on new capital should be 7 per cent. where the standard rate of original capital is 10 per cent. To a provision of this kind there could, of course, be no objection.

On principle, the contention of the Company on this section is based on the proposition that, whatever may be the power of Parliament, it can have no moral right to appropriate the property of one person for the benefit of another, whether that property consists of money invested in shares in a gas company or of real estate, or of any other form of property.

[Counsel was allowed to deal with clause 14 and subsequent clauses of the Bill, as already reported.]

### The Regulation Bill Amended.

The above-named Bill, an epitome of which was given in the "JOURNAL" for the 17th of September (p. 764), was under consideration by a Committee of the Legislative Assembly on the 11th and 12th of that month. The result was several important amendments, which may be briefly indicated. By clause 13, the standard rate of dividend was to be 4 per cent., and the standard prices scheduled to the Bill were 3s. 9d. per 1000 cubic feet for the Australian and North Shore Gas Companies, and 3s. 7½d. in the case of the Newcastle Gas Company—these being the present rates. The dividend was altered to 10 per cent.; and the price to 3s. 3d. in the case of the first-named Company. The prices of the two other Companies were fixed when the schedule to the Bill was reached. Capital raised after the passing of the Bill is to carry 7 per cent. if ordinary, and 5 per cent. if preference. An amendment making the Act apply to all companies, so far as the illuminating power and purity of the gas is concerned, but exempting all but those named in the schedule from the financial clauses, was carried. The illuminating power originally specified was 16 candles, but this was altered to 15 candles. The Minister in charge of the Bill (Mr. Carmichael) submitted a new clause specifying that the gas should have a minimum calorific power of 600 B.Th.U.; but an amendment reducing it to 500 B.Th.U. was adopted. Meters are to be examined and tested by a Government official before being sent out. A new clause was inserted making it compulsory on companies to supply gas to premises within 25 yards of a main, on receiving 30 days' notice to do so; one of the conditions being that the applicant agrees to take gas for a period of twelve months. At the close of the discussion on clauses and the amendments proposed, the Bill was reported.

## LABOUR CO-PARTNERSHIP ASSOCIATION.

### Mr. Corbet Woodall on Co-Partnership in Municipal Enterprise.

A very successful gathering, under the auspices of the Labour Co-Partnership Association, took place last Friday evening, at the Mason College of the Birmingham University, under the presidency of Alderman F. C. CLAYTON (Pro-Vice-Chancellor), who was supported by Lord Norton, Sir William Lever, Bart., Sir Oliver Lodge, and others.

The CHAIRMAN referred to the successful working of the co-partnership scheme in connection with the South Metropolitan Gas Company, and also on a much smaller scale at the Stafford Corporation Gas-Works. He mentioned that Mr. Corbet Woodall, the Governor of the Gaslight and Coke Company, who had promised a paper, was unable to be present; but the paper would be read by the Secretary of the Association (Mr. Williams).

Sir WILLIAM LEVER gave an address on "Co-partnership and Efficiency," urging that the elevation of the workers to the front rank was an ideal worth living for. The next advance they had to make to a higher level must be co-partnership, which would give equal interest and equal responsibility among the workers.

### Mr. Woodall's Paper.

The SECRETARY then read Mr. Woodall's paper, which was on "The Application of Co-Partnership to Municipal Enterprise." In the course of the paper, the author said the main point—and it was no new one—was this: Was not a willing, careful, and interested worker worth more than an indifferent one? Could not a thoughtful hand always save his employers money, if it was made worth his while? The obvious affirmative answer to this question cut the ground from under the feet of those misguided labour politicians who professed to believe that every extra penny earned by one man must be taken from somebody else. He recently noticed a statement by one of these

"blind leaders of the blind" to the effect that he would not object to a certain gas company's scheme of co-partnership if it deprived the shareholders of what the "workers" were to receive. It had evidently never occurred to this person that profit in business was not necessarily robbery. Prevention of waste alone would be a fruitful source of manufacturing profit that could hardly be tapped without the interested good-will of all the employees, high and low. This source of additional gain existed in a municipalized or nationalized employment as much as in a private enterprise—perhaps more so. Call it not "profit," if objection was taken to the word. It might be called "good husbandry." Anyhow, it was money saved, which might be distributed among the employees of all grades.

A BELFAST EXPERIMENT.

He was struck by the experiment in this line of Mr. Nance, the General Manager of the Belfast Corporation tramways, who had prevailed upon his Committee to distribute among the employees a substantial slice out of the yearly profits of the undertaking. This grant went with a handsome contribution to the relief of the rates. It robbed nobody, as it was so calculated that nobody was overpaid—the individual shares not exceeding such an amount "as would be payable on purely commercial principles in the best interests of the ratepayers." These words were taken from a judicial dictum, and were of importance as establishing the mutual advantage of the arrangement. He, however, was unable to agree with the principle of the Belfast precedent in respect of the equal division of the benefit among all employees, irrespective of the rate of pay. This could not be rightful, any more than it would be correct to pay all classes of the service equally. It was one of the evil tendencies of the day to eliminate all consideration of efficiency when fixing remuneration—to pay the inferior worker as though his value were equal to that of the best.

CO-PARTNERSHIP APPLICABLE TO MUNICIPAL UNDERTAKINGS.

There was no difficulty whatever in applying co-partnership to the gas undertakings of municipalities, on the lines laid down by Sir George Livesey for gas companies. A standard price of gas, for this purpose only, would be adopted, and a standard percentage bonus based upon that price. The share of the working partners would move up or down inversely to the price charged for the time being to the consumers. This would work perfectly well, even in cases where the undertakings were run wholly in the interest of the consumers. Where, as in Birmingham, sums were appropriated from revenue towards the relief of the rates, these moneys would, of course, be counted in as profit for co-partnership purposes. The same would apply to the electricity departments. The cases of tramways and water-works, and also of the spending services, were not quite so simple; but in all there was room for improvement in working results. If a certain sum were determined as the normal profit of the year where a profit was made (and such sum might be taken at rather less than the average of immediately past years), the excess gain over the standard might be divided in agreed proportions between the employees and the consumers or the users of the service. In a spending service, it would, of course, be the running expense that would furnish the standard; and the saving would be the divisible gain. In any case, there did not appear to him to be any insuperable difficulty in the way of investing the employees' share in corporation bonds, so as to render the co-partners' interest cumulative. He urged that it was obviously impossible to lay down rules for universal adoption; but certainly something like the division among municipal employees, especially those in gas undertakings, of a reasonable share of the extra profits realized, upon the principles of co-partnership, should be adopted by progressive local authorities, if they were to keep pace with the best gas companies. Circumstances would, of course, govern cases; but if public opinion could only be enlisted in support of the principle for the sake of its social value, ways and means for carrying it out would be found.

The reading of the paper was followed by a discussion.

Mr. CHARLES CARPENTER explained that the scheme of the South Metropolitan Gas Company differed from the one outlined by Sir William Lever in this respect—that the capital owned by the employees in the concern had the same value in the market as that held by any ordinary shareholder.

Mr. CUDWORTH pointed out that in the co-partnership scheme of the South Metropolitan Gas Company the employees had representation in the management. He urged that if this scheme or that of Sir William Lever was not applicable to a particular business, these were only two out of two hundred, all of which claimed their consideration.

The usual votes of thanks were accorded, and the meeting closed.

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On Saturday, Lord ROBERT CECIL gave an address on "The Human Side of Co-Partnership. Dealing with the subject of profit-sharing, his Lordship said the system was incomplete by itself. Having given the workman a share in the profits, they must do more than this—they must give him a share in the capital and in the management. He believed the industries in which co-partnership had been most successful were precisely those where a full share of management had been given to the men. What was the end to be aimed at? Make every man a part-owner of the business in which he was engaged; and any share in the profits given him must be in addition to, and not in substitution for, the standard wage. Co-partnership was not a mere trick or device for increasing the profits of the capitalists; it rested on the principle that the workman must be paid his standard wage first of all, and only after that had been done had he to have in addition a share in the profits. He did not believe that co-partnership would destroy or injure trade unionism. He did hope and believe, however, that it would introduce an entirely different spirit into the bargaining between the two co-partners. The theories he had laid before the meeting, if they were but theories, had been tested by experience; and he held that wherever the experiment had been tried fairly it had succeeded. Certainly if it could produce the results it had produced, it was not a plan to be lightly laid aside.

On the motion of Mr. Henry Vivian, seconded by Mr. F. H. Bruff, and supported by Mr. Charles Carpenter and other speakers, a vote of thanks was accorded to Lord Robert Cecil for his address; and the proceedings terminated.

## WOODALL-DUCKHAM RETORTS FOR WEST BROMWICH.

The West Bromwich Town Council had before them last Wednesday a special report by the Gas Committee on the subject of improving the carbonizing plant. One range of retorts at the gas-works requires repairing and rebuilding; and the Committee have had under consideration the question of whether it would be better to renew the horizontal or instal vertical retorts.

In the course of their report, the Committee stated that in the past quarter there had been a considerably greater demand for gas; and if this rate of increase should be maintained, the whole of the plant for producing coal gas would be required during the coming winter, leaving no margin for contingencies. The present price of gas oil rendered the manufacture of carburetted water gas unprofitable; so that the provision of further carbonizing plant became a matter of extreme importance. The proposed vertical retort installation would furnish an immediate increased producing capacity of 350,000 cubic feet per diem, and would be capable of extension to a like extent on the same ground space in the existing retort-house. Vertical retorts, it was pointed out, had been found more economical in working charges and repairs than horizontals, yielded a larger output of gas of a better and more uniform quality, and gave at least equally good results in residuals. The Committee had visited and closely inspected four installations of these retorts—two at work and two in course of construction; and they expressed the opinion that the adoption of them at the Council's works would unquestionably result in considerable financial advantage to the undertaking.

After considering reports made by the Borough Treasurer and the Gas Engineer and Manager (Mr. Harold E. Copp), the Committee thought steps should be taken to provide an installation, to be ready for the winter of 1913. They accordingly recommended that application should be made to the Local Government Board for sanction to borrow £14,000 for the provision of vertical retorts; and, subject to it being granted, that the tender of the Woodall-Duckham Company should be accepted for the work. In the event of the Council adopting this recommendation, the Committee further recommended that they should be instructed to take steps to repay the whole of the loan within the next five or six years.

A discussion ensued, and the general impression was that the introduction of vertical retorts would be a great improvement. Mr. Brockhouse, the Chairman of the Gas Committee, said they were hoping that they would make out of the proposed small installation a few hundreds over £2000 a year profit. The report was adopted, and Mr. Copp was complimented for the way in which he had assisted the Committee in bringing the scheme forward.

## VERTICAL RETORTS FOR THE LYTHAM GAS-WORKS.

### Local Government Board Inquiry.

The Lytham Urban District Council having applied to the Local Government Board for authority to borrow £8939 for the purpose of modernizing the carbonizing plant at the gas-works by the installation of Glover-West vertical retorts, an inquiry was held into the matter last Thursday, at the Council's offices, by Mr. H. R. Hooper, M.Inst.C.E., one of the Board's Inspectors.

The Clerk (Mr. C. A. Myers) stated that the population of Lytham at the present time was 9500, against 9463 at the last census and 7185 in 1901; that the rateable value was £70,167; and that £6165 had been expended on the gas undertaking, or a total expense for all purposes of £32,514. The district rate had been 3s. 2d. for the last two years. The Council asked for 22 years for the repayment of the loan. Two Orders had been obtained to sanction borrowing—one for £15,000 and the other for £10,000—and the outstanding loan on account of the gas undertaking was £6965.

The Engineer and Manager (Mr. A. Halliwell) stated that there were in the gas-works 92 retorts, having a productive power of 350,000 cubic feet per day; the capacity of the condensers, washers, and scrubbers was 500,000 cubic feet per day; and the four purifiers were dealing with 350,000 cubic feet and could pass 500,000 cubic feet in 24 hours. The new plant would produce 500,000 cubic feet of gas per day. The other retorts would be used in case of requirements in the future. The new carbonizers would be erected on land they had already acquired. The average profit for the past few years had been £1500 annually; the price of gas was low; and the Council had been in the habit of relieving the rates out of profits.

The Inspector observed that he could not say that a process of taking from the ratepayers with one hand and giving to them with the other was more to the advantage of the ratepayers than paying interest on borrowed money. Proceeding to deal with the proposed structure, he asked what was the nature of the ground.

Mr. Halliwell replied that it was rather soft and muddy. No trial had been made of the ground exactly on the site of the new plant; but the estimate allowed for 7 ft. 6 in. of concrete; and there was an alternative scheme for reinforced concrete at the depth of 3 ft. 6 in. He suggested this.

The Inspector pointed out that the first tender had a drawing of the foundation and the second had not; and he suggested that some plans for the foundation were required.

Mr. West, representing West's Gas Improvement Company, Limited, the contractors for the work, said the supplementary tender provided for a foundation to the depth of 3 ft. 6 in. If it was necessary to go deeper, they would charge according to scale.

The Inspector said he should like the Council to see that they were definitely covered on the point of the foundation for the work, as he was concerned about the safety of the structure. He then discussed the period of the loan, and the inquiry closed.

## IMPERIAL CONTINENTAL GAS ASSOCIATION.

The Half-Yearly Ordinary Meeting of the Proprietors was held on Tuesday last, at the London Offices, 21, Austin Friars, E.C.—Mr. J. Horsley Palmer in the chair.

The Secretary (Mr. R. W. Wilson) read the notice convening the meeting; and the Directors' report and accounts [which have already been published] were taken as read.

The Chairman, in affixing the seal to the Register of Proprietors, remarked that there were now nearly 7000 proprietors—an increase during the half year of nearly 86 accounts.

The Secretary read the Auditors' report.

### An Old Practice Revived.

The Chairman then said: Gentlemen, Before proceeding to make a few comments on the business before the meeting, I should like to allude to the fact of the meeting being held on the premises belonging to the Association. It really reverts to an old practice before any of us were in existence. I believe it was 85 years ago that the business of the half-yearly general meetings was transacted at the offices of the Association. I may also say a few words as to the reasons we are meeting here to-day. I think I may assert that it is due to the intelligent progressiveness not only of the Directors, but also of a great many proprietors. In the old days, there were no accounts given, nor was a report made to the proprietors prior to the meeting. Now, they all receive not only the Directors' report, stating the dividend which the Board will recommend, but also a full balance-sheet. This year still further progress has been made in the form of the accounts by adding, at the request of an old and valued proprietor, marginal notes giving the figures for the corresponding half of the preceding year—in this instance, those for the first half of 1911. Therefore the Directors came to the conclusion that there was no use taking for the meeting a large hall which would not be filled—on the last occasion only some thirty proprietors attended—and that it would be to the advantage of all to have the meeting at the offices.

### Explanation as to the Profits.

Now, gentlemen, I will proceed to make a few remarks on the business. We will, if you please, take the balance-sheet first; and I should like to speak at the outset about the profits. The profit made during the half year amounted to £248,008. That is a decrease of £33,759 on the corresponding period of 1911. I think that in past half years I have gradually led you to expect a falling off in the profit, because I have frequently remarked upon what would take place after the loss of Vienna—that is to say, the suburban districts of Vienna, which we had to give up a year ago. There are one or two other causes which also tend to this diminution of profits. The increased cost of coal is one—that is to say, the increased cost of coal which was purchased on the Continent, which came to about 7½d. per ton on the total quantity of coal carbonized. There was, also, the lower value of coke, which was about 5d. per ton. During the half year, we have also given a gratuitous supply of gas for public lighting at Hanover under the terms of our new contract; and, of course, as I said before, last but by no means least, there is the cessation of our business at Vienna. I shall presently allude to one or two favourable features in the half-year's working. The profit of £248,008 must be added to the sum of £58,900, which was brought forward from the preceding half year's accounts; so the total sum available for appropriation is £306,908. The Directors propose that this sum shall be divided as follows: Our usual dividend of 4½ per cent. will absorb £222,300, and the customary appropriation to the pension fund £40,000; this will leave to carry to the current half year £44,608. The only other item on the liability side of the balance-sheet calling for comment is that of sundry creditors. Sundry creditors, you will notice from the account, has increased very considerably from what it was a year ago; and this is accounted for by the liability which exists, and which has not yet been entirely redeemed, of our payments to the town of Hanover for the new contract, into which question I entered very fully and particularly at the last half-year's meeting.

### Asset Variations.

We will now turn to the assets side of the account. There are one or two items which, by comparison, exhibit considerable variation. But I may say in dealing with a large Company like this that, with the great interests that are in our hands, and the greater interests that may come into our hands, we are obliged from time to time to have considerable variations on the assets side of the account. That is, I say, necessary in, and inseparable from, a great business—especially one like ours. What I wish to call your attention to is this, that, notwithstanding the deduction from the works and mains account and from that of amortization of the amounts which represented the Vienna business, the net expenditure upon the works and mains, &c., after deduction of amortization, shows an increase of £131,000; and this is arrived at in this way: Including the premium on account of Hanover, additions to works and mains have been made to the extent of £710,000; while the deductions on account of Vienna and of the usual amortization quotas, come to £579,000—resulting in a net increase, as I have just stated of £131,000. Then with regard to another item on the assets side, there are the loans in London, and to subsidiary gas and electricity companies. Well, as regards London, it is a mere question of where our money is. We found, for various eventualities on the Continent, it was desirable to keep a much larger sum at the principal stations like Berlin and other places, instead of having the money in London, and not only so, but we were able to get a better rate of interest for the money. This accounts for the large increase of £229,000 in the item cash at stations. As to loans to gas and electricity companies, which show a decrease of £109,000, this is owing to the fact that certain loans we made to these companies were, during the half year, converted either into debentures or shares, which we took up in place of the loans which had been running. These are perfectly good investments, and progressive ones as well.

### The Pension Fund.

There is another point in regard to the balance-sheet. I remember last May Sir John Runtz rather criticized the Directors' policy of increasing the pension reserve fund, and also made the suggestion that perhaps we could in some way liquidate certain of these pensions by paying lump sums down. This is a matter the Directors took very seriously into consideration. There are on the Continent, as in England, many bankers and insurance companies who deal in this class of business; and, of course, they are prepared, on certain terms, to take up a great mass of pensions—naturally, in the hope of making money out of them. We should, however, have had to pay a large sum. After going carefully into the matter, the Directors came to the conclusion that it would be more advantageous to the Association to run these risks themselves than to pay others for taking them. I should like to read you some extracts from a letter, if I may, from a very old proprietor. This proprietor is a lady, and apparently a very shrewd business woman. She has been a holder of our stock for more than thirty years; and her letter is entirely an uninspired one. It was written immediately after she received the report of the proceedings at our meeting six months ago. She first of all presents her compliments to the Chairman, and then expresses regret that she was unable to be present at the last meeting. Had she been there, the letter proceeds, she would have wished to have expressed her satisfaction that 10 per cent. of the large annual profits of the Association should go to those who are working to make these profits, and to the persons dependent upon the workers. She does not think 1½ per cent. upon the capital stock in the least too high a sum to place to the account of the pension fund. I thought it only fair that the letter should be read to you.

### Consumption of Gas and Propaganda Work.

I have given you some of the unfavourable features of the half year; and now I should like to give you some of the favourable ones. With regard to the consumption of gas, the profits of the half year, owing to abnormal circumstances, are lower; but the consumption of gas continues to expand at a healthy rate. More gas to the extent of 5½ per cent. has been sold; and the additions to the lists of consumers can only be regarded as very satisfactory. There is also another feature in this consumption of gas which it is well to mark. It is that the continual average decrease in the consumption of gas used per consumer, which has been noticed for some years, has apparently come to a stop; and we do sincerely hope that the energetic propaganda which is being carried on at all our stations in demonstrating the advantage of gas for cooking and other purposes will cause much better results in the future. We have followed very closely on the lines and the examples which have been set us in England by the great London and other gas undertakings. Suitable people have been engaged to show cooking and heating as well as lighting appliances of the best types, and to demonstrate their utility. We have also engaged first-class lecturers, and have granted facilities for the acquisition of the newest types of apparatus. We also help our customers with advice from time to time, as well as maintain their fittings in proper condition.

### Ninety per Cent. of the Vienna Loss Retrieved.

As a proof of the satisfactory manner in which the consumption of gas is rising, I may mention that, during the three months ended Sept. 30 last (this is a little extra information outside the working of the half year), we have had an increase at the average rate of 9 per cent.; and although we lost Vienna only last year, we have already got back about 90 per cent. of the loss of gas consumption sustained through the taking over of these works by the Municipality. This gives you some idea not only of the progress of this business, but of the way our people abroad are pushing it.

### Coal and Coal Owners.

I should like to say a few words about our coal contracts. Fortunately, we are in a happy position with regard to English coal, inasmuch as contracts for coal were entered into on very favourable terms for a period of two years. So that, at the present moment, we are not feeling the effects of what I may call the unjustifiable figures to which the prices of coals have been pushed. We feel rather strongly on this subject; and so do the administrators of a good many London and British gas companies. Our contracts will carry us on until about next March; and by that time we hope there will have been some lowering of the price. Unfortunately, at the present time, coke is not responding to the increase which we generally expect when coals rise. We have had considerable sales; and we have got rid of our great stock of coke at the various stations abroad. I hope before the next meeting, when we are contracting for English coals, the existing inflated prices will have vanished.

### Exit the Aix-la-Chapelle Station.

I cannot, of course, sit down without referring to the loss of the Aix-la-Chapelle station. We have been lighting that town for 74 years. But the time came when the Municipality determined to take the business into their own hands. Though we offered them most favourable terms—in fact, terms from which some of the Directors felt inclined to shrink—nothing would induce them to prolong the contract; and notwithstanding the efforts of our good friend and representative on the Continent (Herr Delbrück), they still adhered to their intention to buy out the property of the Association in the town. They have to pay us about £300,000; and the investment of this money in our other businesses ought to bring us in very nearly as much as we should have obtained had we entered into a new contract with the town.

### Works' Inspection.

I may say that all the stations of the Association have recently been visited by members of your Board. Sir Charles Jessel and Colonel H. Le Roy-Lewis have visited Antwerp, Flushing, and Hanover; Mr. Tindall and Mr. Wilkinson have been to Berlin and the Bohemian stations; while Mr. Arthur Lucas, the Deputy-Chairman, has visited Antwerp and Brussels. They have come back, and have assured me that we are fully ready to meet the demands, and the increasing demands, for gas that will come upon our works this winter.

### Spreading Outwards.

You may have noticed in the report that, though we have not been able to obtain any additional great town, we are still extending the system of drawing into our business the principal communes which surround the greater cities we supply, and this especially in the neigh-

bourhood of Antwerp, Hanover, and Berlin. It is a policy which has been adopted with success and benefit to the Association during the last 25 years.

LOSSES OF OLD OFFICERS.

Of course, with an old Association like this, death is continually claiming old friends and employees. I regret to report that since June 30, we have lost two. One of them was a valuable officer in the home office, and was with us 33 years. I daresay some of the old proprietors remember Mr. Thompson, who before his retirement 17 years ago acted for a short time as Secretary. Another member of that brilliant family which has devoted the whole of its services to the work of the Association (I have often had to mention the Drory family in connection with the Association) has passed away. Only ten days ago we received from Berlin information of the death of Mr. Alfred Drory, who for many years had been the experienced Engineer-in-Charge of our extensive meter-works at Berlin. I have now to formally move the adoption of the report and accounts.

The DEPUTY-CHAIRMAN (Mr. Arthur Lucas) seconded the motion.

Sir JOHN RUNTZ congratulated the Directors upon changing the place of meeting. He had attended meetings of the Association for nearly forty years. The proprietors had been lost in a great hall at the Cannon Street Hotel; and they went to an underground meeting last half year. He thought they would be all pleased that the place of meeting had been changed to the Board room. The Chairman had spoken of the "intelligent progressiveness" of the Association. He (Sir John) presumed he meant that of recent years the Board had sent out the account figures in order that the proprietors might study them at home; and they were so satisfied that they did not need to attend the meetings. There was another side to this question of non-attendance. The business of the Association showed continued and great progress. The proprietors were satisfied the Directors were doing the right thing, and that they had done the right thing. The Chairman had referred to the remarks he (Sir John) had made at the last half-yearly meeting in connection with the pension fund, and spoke of his "criticism." He did not intend to criticize. He was simply somewhat alarmed at the huge amounts transferred each half year to the pension fund; and his remarks were in the direction of an inquiry as to whether some other method could not be adopted with reference to this expenditure. He had no idea of transferring the liability to an insurance company by means of annuities. With such a large staff as theirs, there must, however, be individual cases where the men would rather have some lump sums which would enable them to go into business on their own account, instead of taking annual pensions. That was what he had in his mind. But no doubt the Directors, with their usual carefulness and foresight, had gone very closely into all these various points, and had come to the conclusion that they must still adopt the policy of transferring each half year this amount of £40,000 to the pension fund. With regard to the loss of Vienna, they all knew this was coming; and the Board had well provided for the loss. If they took the figures for this time last year, and compared them with the figures now, in spite of the loss of Vienna, a diminution of £1137 was the only difference. This was indeed very remarkable. The statement of the Chairman as to the progress of the gas consumption since the half year closed was also extraordinary; and he (Sir John) had no doubt that by this time next year the figures would show equally progressive results. It was certainly a notable thing that the output of gas in the various towns showed an increase of 5½ per cent., while the consumers had increased by 8½ per cent. The Association had gone on by leaps and bounds in the past; and it looked as though they were never going to stop.

The CHAIRMAN thanked Sir John Runtz for his complimentary remarks. At the same time, he must point out to him that the net revenue account for the corresponding half year was £281,000; and this year £248,008. The figures Sir John had alluded to included the balance brought forward.

Sir JOHN RUNTZ: That is so, Sir—the available balance.

The motion was unanimously carried.

Moved by the CHAIRMAN, seconded by Sir CHARLES J. JESSEL, Bart., a dividend of 4½ per cent. for the half year was declared, less income-tax, on the £4,940,000 stock.

The CHAIRMAN proposed a vote of thanks to the members of the home office staff, and to the staff abroad, including in the former their able Secretary, Mr. Wilson. He (the Chairman) had said over and over again that the Association was admirably served both at home and abroad. If it were not so, the Directors would not be able to bring forward such reports half year by half year.

Mr. CORBET WOODALL said he seconded the proposition with great pleasure.

Mr. WILSON heartily thanked the Chairman for his remarks, and the proprietors for their kind vote to the staff both at home and abroad.

Sir JOHN RUNTZ moved a vote of thanks to the Chairman and Directors for the excellent manner in which they had directed the affairs of the Association. At the same time, he should like to say that he was glad the Chairman had specially mentioned the name of Mr. Wilson. Those who knew anything about the Association were aware how well Mr. Wilson considered the subject of their coal contracts, and what great value his skill and knowledge in that direction were to them.

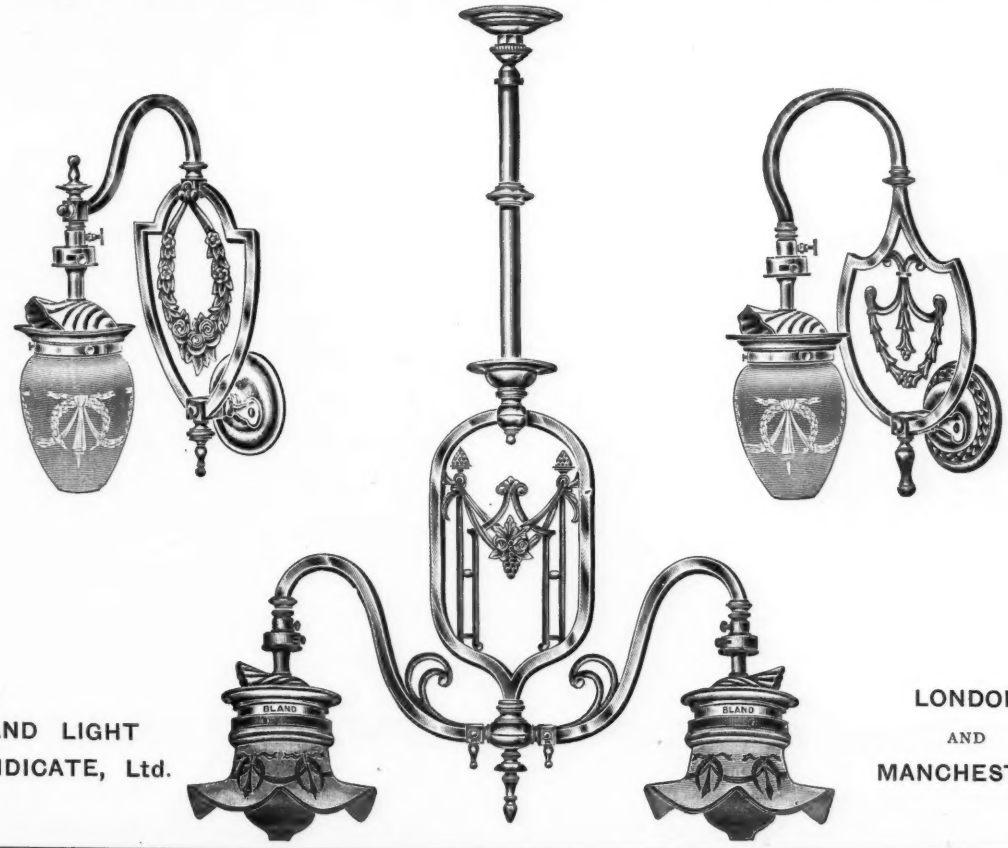
Mr. BERNARD F. HARRIS seconded the motion, which was very cordially passed.

The CHAIRMAN acknowledged the vote on behalf of himself and his colleagues.

This concluded the proceedings.

**New Companies Registered.**—Among the new joint-stock companies recently registered are the following: Moffat, Ross, and Co., Limited, with a capital of £10,000, in £1 shares (5000 being 5 per cent. preference). Thetford Gas Company, Limited (an old Company re-registered), with a capital of £6000, in 250 shares of £10, a like number of £5 shares, and 750 shares of £3 nominal value.


A Few Examples of Fittings taken from BLAND'S Large and Comprehensive List.




The BLAND LIGHT SYNDICATE, Ltd.

LONDON AND MANCHESTER.

## COLONIAL GAS ASSOCIATION, LIMITED.

### Good Progress and Prospects.

The Ordinary General Meeting of Shareholders was held last Tuesday at the Cannon Street Hotel—Mr. SAMUEL SPENCER in the chair.

The SECRETARY (Mr. Alfred J. Kingdon) read the notice convening the meeting and the Auditors' report; and the Directors' report and the statement of accounts were taken as read.

The CHAIRMAN, in moving their adoption, said the Association had again had a very successful year. As the shareholders had all no doubt read the various paragraphs of the Directors' statement reporting the year's doings, he felt convinced they would agree unanimously with what the Board had set out. He was glad to say the Directors had the fullest confidence that the current year would be even better than the past, as Australia was, in the words of a leading member of the Colony, "Surprising in its abounding prosperity;" and in this the Association must share, more in the future, than it had done in the past. As mentioned in the report, the Board had had the pleasure of a visit from the Hon. George Swinburne; and many times he had been with them at the office and at the Board meetings going into the affairs of the Association. When he was leaving, he said: "The Directors might assure the shareholders that the business of the Company was going on as satisfactorily as could be wished;" and that it was with the utmost confidence he recommended them to carry out the extensions now so urgently required, to meet the very great increase of business. The shareholders would have noticed that, during the past year, the increase of consumption was above 16 per cent.; and this year the returns had started with larger increases, especially at two or three of the stations which had shown from 20 to 30 per cent. advance. In last year's report, it was mentioned that the Directors were desirous of securing more works for the Association; and the Board were pleased to say that they were in treaty for two which, they felt confident, with Mr. Swinburne's advice, would turn out quite profitable to the Association. Payment for them would be made in shares. Only that morning, they had received a cable, saying one of the works was secured to them; so that was the first step to a satisfactory conclusion of their proceedings in trying to get the two. The two works had been in operation for some time; and the Association were securing them on terms that would enable them to take them over at somewhat less than the basis of their present dividend-paying rate, with the prospect of increased profit from better management and financial arrangements. During the year, the Board had to issue further capital; and he was pleased to say the whole of it was successfully placed (with a small percentage of outside applicants) among their shareholders at par; and this he might mention was most gratifying to the Directors. At the same time, the 6 per cent. dividend, free of income-tax, made the shares a very desirable and satisfactory investment; and he might intimate here that a further issue of shares would be made in the near future at par. The Directors felt sure they would be readily taken up, as the prospects of the Association were so good. The shareholders would have noticed it was intended to have an extraordinary meeting on Dec. 3, with the view of getting rid of the 60 founders' shares of £10 each, as the Directors considered it would be in the best interests of the Company. It might be well to mention that, at the inception of the Association, it was arranged in the articles that the first 60 shareholders applying for 50 shares of £10 should be allotted one founder's share for £10 in consideration of the payment of £8 6s. 8d., the proportionate cost of the £500 preliminary expenses of the formation of the Company. Since then, over twenty years ago, the £10 founders' shares had received the ordinary dividends paid; but nothing had been paid, as interest or principal, on the £8 6s. 8d.—the inducement in making this payment being that, after 8 per cent. was paid as dividend to the shareholders, any further profit should be equally divided between the shareholders and the founders. It was now thought advisable to cancel the founders' shares; and he was pleased to say, with one or two exceptions, the holders had expressed their willingness to do so upon receiving two £5 shares, covering the £10 shares and the £8 6s. 8d. paid at the starting of the Company covered by £10 paid in cash. To bring about this arrangement legally, it would have to receive the sanction of the Court; and the meeting on the 3rd prox. would be called for the approval of the shareholders to the scheme. In turning to the balance-sheet, it would be seen that the net revenue for the past year was a small amount down. But as this arose entirely from the very liberal reduction they had made in the price of gas, the Board were fully confident, from the large percentage of increase in sales of gas, already mentioned, that the current year would more than make up the difference alluded to; and it must not be forgotten that the loss of profit from the Geraldton works naturally required some good increases to make it up. The Casino works were now pushing ahead, and the Board quite expected very good returns from them. From all points of view the Directors had the fullest confidence that the future of the Association was as bright as could be wished. The capital account had largely increased, and must continue to do so during the coming year. But the Directors thought the shareholders would cheerfully consent to this as the proper policy to pursue, especially as the new capital would be issued in the near future by debentures paying 5 per cent. and ordinary shares receiving 6 per cent., free of income-tax. It would be interesting perhaps to mention that they had carbonized 1400 tons more coal; and the whole of the coal used was practically about the same price as that of the previous year. Salaries and general expenses had increased. This was partly due to the new issue of shares and to the terms and arrangements the Board had, fortunately and with much satisfaction, made with the Hon. George Swinburne to continue his valuable services as a Director of the Australian Board. This, with the assistance rendered by Mr. Andrews, and Mr. William Swinburne (who had been associated with the Company from its start) gave them three Directors in Melbourne, for whose co-operation in the conduct of the business they were most gratified. During the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year, 828 additional meters were fixed and 523 cookers and grillers were installed. These increases were most satisfactory, especially the latter, as a few years ago cookers were not looked upon with favour in their districts; but now they would naturally go on increasing in number. The shareholders would also be pleased to hear that, during the past five years, the consumers had increased from 2294 to 4374; and the number of cookers, &c., in the same period from 802 to 2937—each station having contributed to the increase. The sale of gas during the year was over 9500 cubic feet per ton of coal carbonized, with a total sale of 65 millions; and the capital per million was now down to about £1900, which was quite a satisfactory figure for such gas-works in the Colonies. Stocks of coals were larger, as it was considered advisable to have more coal in store in case of emergency. A further sum of £743 had been placed to the reserve fund account, making the amount £7821—a sum equal to 8¾ per cent. of the subscribed capital. He had every confidence that the coming year would be one of continued success.

Mr. W. C. Parkinson, in seconding, said the Association had gone on fairly rapidly in the past, with great promise of even increased rapidity in future.

Mr. Samuel While asked whether the price of coal had risen in Australia; he had to pay 3s. 3d. more per ton for coal here.

The Chairman thought Mr. While had overlooked what he had said. The prices had been practically the same, and were the same for the coming year.

Mr. W. T. Batten inquired what was the actual price.

The Chairman said that 20s. to 25s. per ton was now the value out there for local coal delivered on the works. The Directors were not making forward contracts; and they were practically buying now from hand to mouth.

The motion was unanimously carried.

The Chairman proposed the payment of a final dividend of 4 per cent., free of income-tax—making 6 per cent. for the year.

Mr. Charles Hunt said he seconded the motion with great satisfaction, not only because the dividends the Directors proposed to pay had been fully and fairly earned, but also because the prospects of the Association were, he thought he might say, brighter even than they were before.

The proposition was adopted.

Mr. Hunt moved the re-election to their seats at the Board of Mr. Parkinson and Mr. Spencer. Mr. Parkinson, he remarked, had been a Director from the commencement of the Association; and he brought to its affairs a ripe experience of gas matters. Mr. Spencer had likewise been a Director from the commencement. He had been their Chairman for many years; and they all hoped he would long fill this post.

Mr. F. R. Smith seconded the motion; and it was cordially agreed to.

Both the Chairman and Mr. Parkinson duly acknowledged their re-election.

The Chairman then moved that Mr. William Swinburne be re-elected a member of the Australian Board. He observed that Mr. Swinburne had been for many years actively connected with the management of the Company in Australia. They were gratified that he was now a member of the Board, in association with his brother the Hon. George Swinburne and Mr. Henry Andrews.

Mr. Smith, in seconding, said that no man knew more of the detail of the Association than Mr. William Swinburne. He was for some time laid aside through illness; but they all rejoiced that he was restored to health and strength.

The motion was heartily carried.

Moved by Mr. Batten, and seconded by Mr. While, the Auditors (Messrs. Wood, Drew, and Co.) were re-appointed.

Proposed by the Chairman, and seconded by Mr. While, a cordial vote of thanks was passed to the General Manager and the staff in Melbourne and at the works. The Chairman mentioned that the works were widely separated; and therefore the claims on the management in Australia and the staff were greater than they would otherwise be.

Mr. John Coates moved a vote of thanks to the Directors at home and in Australia. The whole of the members of the Board had, he said, managed the Company excellently and well for many years. He quite endorsed all that Mr. Hunt had said regarding the Chairman and Mr. Parkinson. As to Mr. William Swinburne (who had just been elected), he could speak of him personally. He did not think he had ever met a man who was such a prodigious worker—a man who did more than his duty, and who attended so assiduously to every detail. No man could attend more to the interests of the Company. He (Mr. Coates) liked the constitution of the Board of this Company, because they were men who had their own businesses to attend to, and were therefore men of experience—not merely men who went from company to company as directors.

Mr. Batten seconded the motion, and spoke of the confidence he possessed in the business qualities of the Board. He had asked a question of the Chairman as to the cost of Australian coal. He himself was at one time associated with a Company in the Far East [Singapore], and was then interested in Australian coal. The price he found, from the figures mentioned by the Chairman, had not greatly increased since then. At that price the gas yield and quality would compare favourably with coal from this country. The quality of the coke was slightly inferior; but, of course, that was practically a negligible quantity.

The motion was very cordially endorsed.

The Chairman responded; and this concluded the proceedings.

---

The new water supply from the Derwent Valley water-works was turned on at Ripley, last Wednesday, by Mr. E. J. Ellis-Fermor, the Chairman of the Urban District Council. Those who were present at the ceremony tasted the water, and pronounced it excellent.


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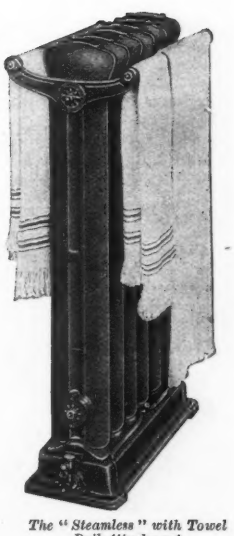

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## FELIXSTOWE PUBLIC LIGHTING.

### Extension of the Gas Company's Contract.

In view of the expiration on the 31st prox. of the existing contract for the public lighting between the Felixstowe Urban District Council and the Gas Company, the Lighting Committee of the Council invited the Company and the Suffolk Electricity Supply Company, Limited, to submit tenders for a new contract for a period of four years from Jan. 1, 1913, with an option for the Council to extend it to seven years. Both Companies were to tender for lighting the whole district, excluding the Promenade, as this forms a separate contract with the Electricity Company; and the Gas Company were asked to submit an alternative tender for lighting the whole district by gas, excluding the portion in which electric poles and mains have already been erected, or are likely to be erected by the end of the year, out of capital provided by the Council. The Electricity Company were also asked to tender for this portion of the district. Each Company tendered for lighting the whole of the district; but only the Electricity Company complied with the request for a tender for the part specified. Both Companies, however, submitted alternative tenders on their own initiative. The Committee specified for certain additional lighting. Altogether, nine tenders were sent in—four by the Gas Company and five by the Electricity Company. While these were under consideration, the latter Company informed the Committee that they claimed the right to light all roads within a radius of 150 yards from the Promenade, in accordance with an agreement entered into as far back as the summer of 1903; and they said that they should insist upon their right. Accordingly, the Gas Company were invited to send in a tender for lighting the whole district with the exception of the portion just referred to; and they did so—their offer for a minimum of 235 lamps being £611 17s. 6d. per annum, with a guaranteed illuminating power of 25,200 candles, on a seven years' contract. The majority of the Company's lamps are of 75 and 100 candle power; and for each of these the Council are paying £3 0s. 10d. net per annum, whereas under the above tender they would pay only £2 7s. 6d. The Committee pointed out, in connection with the Electricity Company's tenders, that if any of them were accepted the Council would have to provide the necessary capital for carrying out the work, amounting to from £2500 to £3000, for which, however, they would receive 6 per cent. interest under an agreement. But in addition to the prices named in the tenders, the Council would have to reimburse the Company every year a certain sum in part repayment of the interest. After prolonged consideration of all the tenders, the Committee recommended that the Gas Company's be accepted for lighting the whole of the district by gas, excluding the radius of 150 yards from the back of the Promenade, for a seven years' certain contract from Jan. 1, 1913, at the price of £611 17s. 6d. per annum; and that the Suffolk Electricity Supply Company be given the street lighting within the radius of 150 yards from the back of the Promenade for a seven years' certain contract from the same date, on terms to be agreed as to the amount of the yearly payment. The recommendation came before the Council at their meeting last Wednesday, and was agreed to. The result is that the Electricity Company will replace 44 gas-lamps in the 150 yards area, and the Gas Company will take over the existing electric lighting in the town—at present a total of 18 lamps.

## NOTTINGHAM GAS PROFITS.

In curious contrast to the experience in some previous years, little was heard, during the recent municipal contests in Nottingham, about matters appertaining to the Corporation gas undertaking. But a November in Nottingham without some reference to the gas undertaking would appear to be scarcely in keeping with the fitness of things, and the omission was made good at the Mayor-making meeting, when a report was presented by Mr. T. C. Leman, one of the City Auditors, containing a passage which calls for notice. During a recent debate in the Council, Mr. E. Harlow, a former Chairman of the Gas Committee, directed attention to the undue raiding of gas profits in relief of local rates, and quoted an article from the "JOURNAL" embodying the view that the matter in its general bearing was one calling for Government Departmental notice. The fact of an annually increasing drain upon the revenue-earning capacity of the undertaking was not denied, nor was there any attempt to defend the practice on equitable grounds; the general plea being that the Committee could afford to make the grant and had deemed it fitting to do so. But the matter has not been allowed to rest. A good deal has been heard about it since outside the Nottingham Council, and, naturally enough, among the largest consumers.

Mr. Leman, in his report, has, therefore, considered it necessary to engage in what savours very much of special pleading—not ordinarily associated with the strict task of auditing accounts—when he pronounces *ex cathedrâ* the opinion "that the reserves on the gas undertaking are of so substantial a character, and the financial position so satisfactory, that it is obvious that, without any injury to the concern, any profit earned, after providing for sinking fund contributions, can be properly and reasonably applied in reduction of the rates for other purposes extraneous to the gas undertaking itself." Of the glaring extent to which the doctrine has already been allowed to be applied in Nottingham, Mr. Leman's report supplies the proof. He points out that the profits for the past year amounted to £106,595, as compared with £103,713 for the year ending March 31, 1911—an increase of £2882. There was a net balance of £49,710, which was applied thus: Contributions to the general district rate, 1912-13, £39,000; amount added to renewals account, £3400; amount added to reserve fund, £7310. The profit for the year, £106,595, before making provision for interest and contributions to sinking funds, represents, he further points


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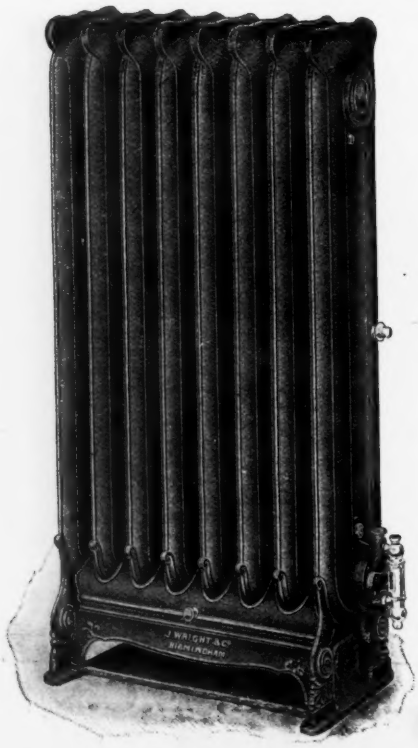


of the **"ST. ANDREW"** over other types of Radiators is the—Steam Principle.

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Automatic control of the gas be ensured.

This makes for Ideal Economy and Ideal Comfort!

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out, 9·87 per cent. on the capital employed in the undertaking. It will need, however, a good deal of special pleading, and some more cogent reasoning than has been yet forthcoming, to allay the irritation which appears to be growing in Nottingham, as elsewhere, against the undue milking of gas profits.

At Saturday's meeting of the Council, Alderman A. Ball was again elected to fill the position of Chairman. Aldermen Ball, Ford, and Radford, Councillors Bowden, Coggan, Coupe, Freckingham, Gover Ford, Orgill, Parkes, Shipstone, and Spray were elected as the members of the Gas Committee for the ensuing year; Messrs. Coggan and Orgill being new members.

## MIDDLETON GAS UNDERTAKING.

### Inspection of the Works—Opening of a Gas Exhibition.

Members of the Middleton Town Council paid a visit to the gas-works last Wednesday, and, under the direction of Mr. W. H. A. Chester, the Engineer and Manager, inspected the improvements that are being made to increase the efficiency of the producing plant. Later in the day the party were present at the opening of an exhibition of gas-fires, radiators, water-heaters, &c., at premises in the Manchester Old Road, in the centre of the town, and lighted during the evening by high-pressure gas-lamps. At a social gathering which followed at the gas offices, Mr. A. Parker, the Chairman of the Gas Committee presided, and a toast-list was gone through.

"Success to the Gas Department" was proposed by Mr. J. Wiggins, a member of the Council, and with it was coupled the name of the Chairman of the Committee. Mr. Wiggins said they had first to thank the Committee for the opportunity afforded of inspecting the gas-works; and secondly for the hospitality extended to members of the Council. He was certain they could congratulate the Committee on the way in which the works were kept, and also upon the efforts that were being made to encourage people to use gas more largely for cooking and heating. The latter would mean an increased output of gas, and have a tendency to bring about a reduction in the charges to nearer the cost. If the Committee induced people to use gas-fires instead of coal-fires it would be also to the general good of the community in a lessening of the smoke evil. As Chairman of the Electricity Committee, he did not fear in any way the competition of the Gas Committee, so long as it was carried on in a fair and proper spirit. Whatever improvements might accrue through fair competition between gas and electricity, users of both were the people who would feel the benefit.

In his response, Mr. Parker said there were people who did not want the Committee to make big profits; but they would certainly do their best to keep things going as well as they were doing.

Mr. Chester also replied on behalf of himself and the staff. He said he hoped that before long they would have a permanent show-room in the town for the use of the Gas Department.

## COKE-OVEN GAS FOR TOWN SUPPLY.

The report of the gas undertaking of Mülheim-on-the-Ruhr for the twelve months ended March 31 last is interesting on account of the whole of the gas supply having been taken from two coke-oven works. As a consequence, the accounts show no receipts in respect of bye-products. The year is also distinguished from previous years by the fact that a uniform price has been charged for gas for all purposes, instead of the differential prices which previously prevailed. There has also been a great extension in the use of prepayment meters and the hiring of fittings.

For the reasons indicated, the work of the past year is, therefore, not comparable with that of previous years. Other factors which affect the comparison are that, while industry has showed continuous improvement, compulsory 8 o'clock shop-closing has been introduced. The supply of the district of Nord-Styrum has been transferred from the Mülheim works to the Oberhausen Corporation gas-works—a change which, naturally, has tended to reduce the output of gas from the Mülheim works. The price now charged for gas for cooking, lighting, and heating purposes, is uniformly 2s. 10d. per 1000 cubic feet, with certain rebates for supplies for industrial purposes and special heating installations. The number of public lamps supplied from the works was, on March 31, 1638, compared with 1568 the previous year.

The quality of the gas supply was continuously checked in the laboratory of the gas undertaking. Analyses of the supplies from the two coke-oven works gave the following average composition and calorific power.

| — | Oven Gas from the Friedrich Wilhelm Mine. | Oven Gas from the Deutscher-Kaiser Works. |
|---|---|---|
| Nitrogen per cent. by volume | 6·9 | 4·8 |
| Carbonic acid ,, ,, | 0·8 | 1·6 |
| Oxygen ,, ,, | 1·4 | 0·6 |
| Carbonic oxide ,, ,, | 4·2 | 4·7 |
| Hydrogen ,, ,, | 56·3 | 55·6 |
| Methane ,, ,, | 28·1 | 30·2 |
| Heavy hydrocarbons ,, ,, | 2·3 | 2·5 |
| Calorific power: B.Th.U. per cubic foot | 551 | 571 |

The gas supplied was always free from sulphuretted hydrogen, ammonia, and cyanogen, and its sulphur content did not exceed the permitted limit. The illuminating power averaged 10 to 11·1 candles, and the specific gravity ·408.

The quantity of gas supplied in the twelve months was 6,956,980 cubic


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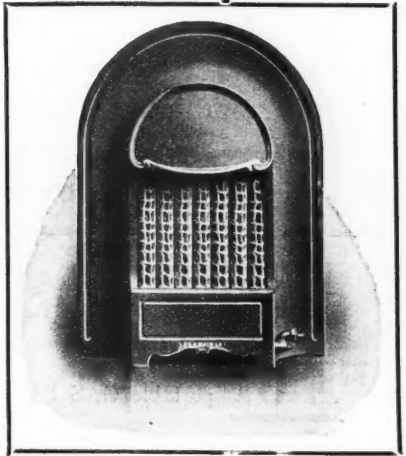
The total number of Fires ordered at the recent Smoke Abatement Exhibition at Glasgow was **2758.**

The number of Makers exhibiting was **11.**

If the orders were divided equally each Maker's proportion would be just over **9 per cent.**

But the orders were divided according to public opinion, and our share was **23 per cent.**—easily the largest.

Our Gas Fires look well, heat well, and sell well. They appeal to the public, the expert, and the salesman.



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metres (245,692,700 cubic feet), which is an increase of 9·98 per cent. on the output for the previous year. The unaccounted-for gas amounted to 11·1 per cent. of the total output, as compared with 11·7 per cent. the previous year. Public lighting was responsible for 15·1 per cent. of the total output. In view of the peculiar conditions under which the Mülheim gas undertaking is working, it may be worth while giving the following approximate receipts and expenditure for the year.

*Expenditure.*

| | | |
|---|---|---|
| Paid for gas | | £8,698 |
| Repairs | | 1,165 |
| Wages | | 758 |
| Working, lamp and general expenses, salaries and pensions | | 5,401 |
| Surplus :— | | |
| Written off | £5,403 | |
| Profit | 10,098 | |
| | | 15,501 |
| | | £31,523 |

*Receipts.*

| | |
|---|---|
| Gas and meter rentals, stores, and workshops | £31,460 |
| General receipts | 63 |
| | £31,523 |

**Failure of Light at Liverpool Street.**—Some confusion was caused last Friday evening at Liverpool Street Station, E.C., through the sudden failure of the electric light. All the lights, both inside and outside the station, went out just before six o'clock, when the place was thronged with passengers. Fortunately the station throughout is fitted with gas-lamps, and these were at once lighted. The electric current was restored within a few minutes.

**Water Supply at Colon.**—According to some particulars given in "The Times," the plans for the new water supply works at Colon, Panama, which are designed to provide up to about 6 million gallons per day (double the present demand), include the construction of a 600-feet tunnel at a point three miles east of Quebrancha, through the ridge separating the watershed of Gatun Lake from that of Brazos Brook, and at an elevation of 65 feet above sea-level, or alternatively the laying of a 20-inch pipe through the divide in an open cut; the laying of a 20-inch main from Brazos Brook to Mount Hope, and the construction of an aëration chamber, mixing-box, head house, sedimentation basin, filter building, and pumping-station. The filtration plant is to be of the rapid mechanical gravity type, designed to deal with the maximum supply. The steam pumping plant now employed will be transferred to the new station for the normal supply, and two electrically-driven centrifugal pumps, each of 3000 gallons per minute capacity, will be installed for use in case of fire.

## DERWENT VALLEY WATER ARBITRATION.

### The Arbitrator's Award.

There was given in the "JOURNAL" for the 22nd ult. (p. 308) a report of arbitration proceedings before Mr. C. A. Russell, K.C., between the Derwent Valley Water Board and the Corporations of Sheffield, Leicester, Nottingham, and Derby. The proceedings arose out of a resolution by the Board—"That the entirety of the Board's works, including the entire length of the aqueduct as constructed by the Board, is to be regarded as one joint undertaking." The Sheffield Corporation disputed this, and argued that, according to the Act, they were not liable for works entirely for the benefit of other towns. The sum which they declined in this way to be saddled with was £295,648. The following explanation of the award of Mr. Russell is taken from an article in the "Sheffield Daily Telegraph," headed "Sheffield's Notable Victory."

When the arbitration proceedings were in progress, Mr. William Terrey, the General Manager of the Sheffield Corporation Water-Works, presented a statement showing how the capital cost of the works should be adjusted between the four Corporations concerned—Sheffield, Nottingham, Leicester, and Derby. This statement puts the case in a nutshell. The total capital expenditure on the works amounts to £3,229,246. What the Arbitrator had to decide was how much of this should be borne by each of the four partners in the undertaking. Sheffield put forward one contention, and the Board another. These were the figures before the Arbitrator :—

| | Sheffield's Contention. | | Water Board's Contention. |
|---|---|---|---|
| Sheffield liable for | £511,664 | .. | £807,312 |
| Derby liable for | 852,563 | .. | 807,312 |
| Leicester liable for | 1,327,963 | .. | 1,153,486 |
| Nottingham liable for | 537,056 | .. | 461,136 |

The Derwent Water Board, therefore, wanted to saddle Sheffield with £295,648 more of the cost than Sheffield felt it was liable for, and to relieve Derby of £45,251, Leicester of £174,477, and Nottingham of £75,920. The Arbitrator has practically accepted the Sheffield figures. Instead of adding £295,648 to the Sheffield bill, he has put on less than £50,000. This amount is in respect of the land through which the aqueduct for the other towns passes, and of the service reservoir at Ambergate. Sheffield argued that, according to the Act, they were not liable for works which were entirely for the benefit of other towns. This view has been maintained, with the inconsistent exceptions mentioned, which cannot be supported in equity. The result is a notable victory for the position taken up by Sheffield.

The Arbitrator awards that, on the construction of the Derwent


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**FIRST** GAS FIRE to have clear hood without pockets or obstructions in flue-way; also the full width oval flue-nozzle.

**FIRST** to be fitted with **Fuel** — vertical, double-length, flames burning inside and shallow fire.

**FIRST** with Duplex Burner, Gas and Air Adjustment, "Venturi-Tube" Burner, Regenerative Copper Reflector, &c.

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Valley Water Acts, 1899 to 1909, and, in particular, of section 85 of the principal Act, the expenditure of the Board in respect of any lands by the said Acts should be borne by the four Corporations in the ratio of the statutory proportions; and it is also held that the expenditure in respect of any reservoir should be similarly borne. The four Corporations have to share in proportion the expenditure in respect of works described as Birchinlee Village, Ashopton Inn, Central Offices, river gauging, Derwent River weir, millowners' compensation, disposal of plant, and afforestation. The aqueduct from Jubilee Cottage to Sheffield tunnel has to be paid for between them, constructed as it is for the purpose of conveying 2,625,000 gallons a day to Derby, 3,750,000 gallons to Leicester, 1,500,000 gallons to Nottingham, 2,625,000 gallons to Sheffield, and 2,500,000 gallons for supplies to local authorities in the county of Derby, if and when such supplies should be required.

It is found that works described as south of Sheffield tunnel, Grindleford and Rowsley, Rowsley and Whatstandwell, and Whatstandwell to Ambergate, are constructed for the use of the Corporations of Derby, Leicester, and Nottingham, and for local authorities in the county of Derby; Ambergate to Heage and Heage to Lang Mill, for Nottingham and local authorities in the county of Derby; Ambergate to Belper and Belper to Coxbench, for Derby, Leicester, and local authorities; and Coxbench to Sawley, for Leicester and local authorities. By reason of the provision for the local authorities in the county of Derby, it is held that the expenditure on each of these works is substantially greater than it would otherwise have been.

So much of this expenditure as is attributable to the provision made for the local authorities is to be borne by the four Corporations. This amount is to be ascertained in the following manner, explains the Arbitrator: "I call the expenditure of the Board in respect of each of the said works "A;" the estimated cost of such work if no provision had been made for carrying county water "B;" and the estimated cost of a work exclusively for the purpose of carrying Derby county water to the same extent as provided for by the said work, "C." I award and determine that an amount which is the same fraction of "A" as "C" is of the sum of "B" and "C" is in the case of each of the said works that part of the expenditure of the Board for the purpose of carrying into effect the provisions for the supply of Derby county water. The rest of the expenditure in these respects is to be expenditure which should not be borne by the four Corporations.

The Arbitrator holds that the Bamford filters were constructed for the treating of water to be supplied to Derby, Leicester, Nottingham, and local authorities in the county of Derby; the Board having been released before the construction of the work from the obligation imposed on them so far as it related to Sheffield. So much of the expenditure as is attributable to the provision for filtering water for the local authorities in the county is to be borne in the ratio of the statutory proportions; but the Arbitrator is unable to say in what manner the amount shall be ascertained. The expenditure of the Board in respect of this work, except the portion relating to the local authorities, is held not to be expenditure which should be borne by the four Corporations. Parliamentary and establishment expenses are to be borne by the four Corporations in ratio of the statutory proportion; and the expenditure of the Board in respect of interest and loans is to be borne in the same manner as the expenditure to which the loans have been applied.

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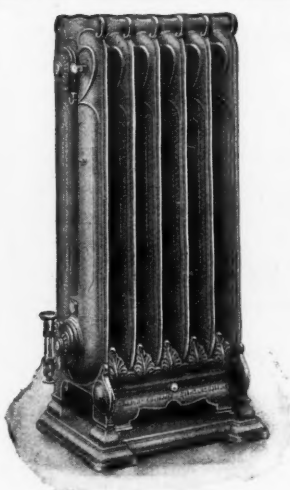
[From Our Nottingham Correspondent.]

Upon a very imperfect digest of the judgment, and a lack of adequate appreciation of the technical points involved, the judgment was at first regarded as in the main supporting the contentions put forward on behalf of the Nottingham, Leicester, and Derby Corporations; but an analysis of the award dispels this too hurriedly accepted view, and shows that Sheffield has to a large extent succeeded in establishing the basis of settlement for which it has from the first contended.

Stripped of legal verbiage, the plain question involved was whether the "Cutlery Metropolis," under its share in the arrangement, was liable for the cost of any of the works undertaken below the point at which is situate the tunnel through which the water reaches the Sheffield mains. The argument was that Sheffield ratepayers ought not to be called upon to contribute anything towards the cost of the reservoirs and 55 miles of aqueduct beyond that point, which were for the benefit of the other municipalities concerned. But for the latter, it was contended that the scheme must be taken as a whole, and that the incidence of cost devolving upon the several authorities must be in proportion to the amount of water which, under the statutory powers conferred, was allocated to each. The resolution carried by a majority of the Board, and which through the arbitration proceedings Sheffield sought to upset, made Sheffield liable to contribute £807,312 towards the capital expenditure of £3,229,246 already incurred upon the first portion of the works. The Sheffield case was that their contribution should be only £511,664; and how much this meant to the other authorities is evidenced by the fact that, if the Yorkshire argument held good, Leicester would have to pay £174,477 more than it would under the arrangement devised by the majority of the Board, Nottingham an additional £75,920, and Derby an extra £45,251. Put in another way, the effect of the resolution, if upheld, would be that Sheffield would have to pay £15,229 a year more for works which it was argued were of no value to the Yorkshire town; Leicester, the largest partner in the scheme, being thereby relieved to the extent of £9002 annually, and Nottingham and Derby by £3939 and £2288 respectively.

When, upon an imperfect interpretation of Mr. Russell's award, the information was disseminated in Nottingham that the town was being saved £75,000, or an amount which, upon the basis of annual contribution, might have been represented by the addition of 1d. in the pound to the district rate, there was not unnaturally a good deal of felicitation; for Nottingham ratepayers have not taken very kindly to the Derwent scheme since, by the discovery of new sources of supply nearer to their own doors, it has been demonstrated that there is little or no

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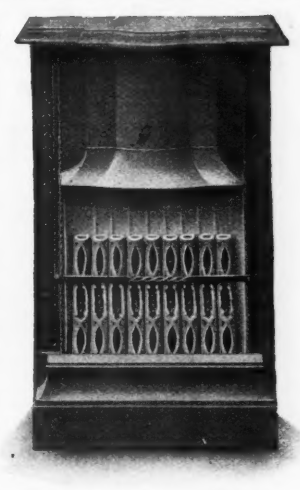
THE rise of the iron industry in Scotland dates from the establishment of the Carron Ironworks, near Falkirk.

—*Encyclopædia Britannica.*



PLAIN PATTERN.

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CARRON has been a name of renown since the reign of George II. The history of Carron Company, since their beginning in 1759, is one of continued enterprise and progress. By strenuous endeavour, by the adoption of scientific methods of manufacture, and by the exercise of expert supervision and labour, a uniform high quality has been maintained in all "Carron" productions, to-day acknowledged as "*The World's Standard.*"

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necessity for the expensive process involved by the impounding of the head-waters of the Derbyshire Valley. But considerable disillusionment has come with a full knowledge of the meaning of the award, which shows that Sheffield have practically won their case—leaving Leicester, Derby, and Nottingham to foot most of the bill.

Mr. Russell has decided that the expense in the proportion fixed by the Act shall be borne jointly by the Corporations concerned, so far as the expenditure upon lands and reservoirs goes. The cost of the aqueduct as far as the Sheffield tunnel has also to be similarly met by the four authorities; but south of this point Sheffield is relieved from liability, save in regard to such expense as has been rendered necessary under the Act in providing for the wants of local authorities—a cost inseparable from the scheme, and which the Arbitrator therefore finds must be borne by the four authorities. The expenditure of the Board in relation to the Bamford filters, except the part relating to the local authorities, is also decided not to be expenditure which should be borne by the four Corporations. Establishment and parliamentary expenses are to be contributed to by the four in the statutory proportions laid down; and the expenditure of the Board regarding interest and loans is also to be borne in the same way as the expenditure for which the loans have been used. As indicated, therefore, Sheffield's contentions have met with ample vindication.

It is clear that with Nottingham's present heavy indebtedness, very rigid economy will have to be exercised if any addition to the present considerable district rate is to be avoided to meet the cost of the Derwent Valley scheme. Steps to obviate this unpleasant contingency have already been taken, in the direction of a thorough overhauling of the rates imposed upon customers for the existing supply, with the result that a substantial increase of revenue has been secured; while economies effected in regard to many matters of detail have further strengthened the financial position. It is a matter of general regret that the Joint Board charged with the control of the Derwent undertaking is at this juncture losing the valuable assistance of Sir Edward Fraser, who succeeded the late Alderman Gainsford in the chairmanship. Sir Edward, who is a Director of the Great Central Railway Company, and has been four times Mayor of Nottingham, resigned his position a few days ago as an alderman, and with his severance from the Corporation his tenure of office as a member of the Board ceases—the statutory arrangement requiring that those forming the body must be members of the constituent authorities. Alderman J. Jelley, who has been long associated with Sir Edward in the work, has been re-elected to serve on the Board, with Councillor A. R. Atkey, Chairman of the Water Committee, as his colleague, to represent Nottingham—it being an interesting circumstance that Mr. Atkey, who is now the head of the Committee responsible for the administration of the Nottingham undertaking, was himself some years ago a clerk in the Corporation Water Offices.

At Saturday's meeting of the Council, high testimony was borne to the great value of the services to the Municipality of Sir Edward Fraser, who had been for 36 years a member of the Corporation, serving for a considerable period as Chairman of the Finance Committee; and upon the proposal of Alderman F. R. Radford, a former Mayor, seconded by Alderman Sir J. T. M'Craith, it was referred to the General Purposes Committee to consider in what manner Sir Edward's work might be most fittingly commemorated.

## SOUTH-WEST SUBURBAN WATER COMPANY.

### Inspection of a New Filter.

A number of guests recently accepted the invitation of the Directors of the South-West Suburban Water Company to view their works at Egham Causeway, and inspect a new filter which has been erected there. Under the guidance of the Engineer (Mr. D. Rankine), the visitors went through the works, and had explained to them the method of treating the water from its abstraction from the Thames until its discharge into the mains for delivery to the consumers. Originally the purification of the water ended with its treatment in the filter-beds; but new apparatus has been installed by which it is further purified. After the water has left the sand filters, it flows into a covered concrete contact chamber, containing half-an-hour's flow at the maximum capacity—viz., 3 million gallons per day; precautions being taken to prevent cross-currents, and ensure the water occupying the full time to pass through. As the water enters, it receives a dose of chlorine solution from the automatic apparatus. After it has gone through the contact chambers, it flows upwards through three other chambers, each containing special granulated vegetable carbon, which removes any trace of chlorine there may be at the expiration of half-an-hour. After leaving these chambers, the water runs into the well, and is pumped up for supply to the consumers.

After the inspection, the company partook of luncheon, under the presidency of Mr. E. Stopford Jones, the Chairman of the Company. In welcoming the guests, he furnished particulars of the various improvements which have been effected in the works, and said he thought he could claim that the district which the Company served with water always commanded the attention and consideration of the Directors. The Rev. G. J. Kingston, Vicar of Bedfont, replying on behalf of the guests, complimented the Company upon their enterprise, and wished them every success. Mr. H. Smith, of Messrs. James Simpson and Co., proposed the health of the Chairman. He said a large amount of engineering difficulty was encountered; but it had been overcome under the guidance of their earnest and painstaking Engineer. The Chairman acknowledged the toast.

A gas stoker named Thacker, employed at the Windsor Street gas-works of the Birmingham Corporation, was last week admitted to hospital, suffering from burns to the chest. He was occupied in closing a retort, when the flames caught his clothing.


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# GAS METERS

**With Patent COMBINATION "STOP & SLOT" ACTION.**

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## NOTES FROM SCOTLAND.

**From Our Own Correspondents.**

*Saturday.*

**Edinburgh.**—The gas exhibition promoted by the Edinburgh and Leith Corporations' Gas Commissioners was visited by 65,000 persons—an average of 6500 daily. The number of those present in the Waverley Market on Saturday, Nov. 2, the closing evening, was 10,000. Mr. Robert Kirk Inches, who on Friday was elected Lord Provost of Edinburgh, has taken a keen interest in the work of the Edinburgh and Leith Corporations' Gas Commissioners. He has been a member of the Commissioners for a number of years, and for a period he was the Convener of the Finance and Law Committee. At present he is the Convener of the Works Committee. A prominent Freemason, the new Lord Provost is one of the principals of the firm of Hamilton and Inches, Princes Street; and he holds, "for all the days of his life," the appointment of "Clockmaker and Keeper and Dresser of His Majesty's Clocks, Watches, and Pendulums in His said Kingdom of Scotland." He is also a Liveryman of the Worshipful Company of Clockmakers.

**Aberdeen.**—Some damage was done to the property known as Crown Mansions, Union Street, on Monday, by gas from a main becoming ignited by a fused electric wire.

**Dundee.**—A private meeting of the Town Council was held on Thursday to make preliminary arrangements for the selection of bailies and conveners. Some surprise was occasioned in the filling-up of the office of Gas Convener. Mr. R M. Moble was transferred from the chairmanship of the Public Health Committee to the chairmanship of the Gas Committee; the latter position having been formerly held by Mr. William High, who has been back-seated on account of his statements on the amalgamation scheme.

**Dunfermline.**—Much secrecy is being observed by the Dunfermline District Committee regarding the provision of a new water supply for the West of Fife, if not for an area extending much beyond the jurisdiction of the Committee. The Glenguey works, which cost £200,000, are absolutely inadequate to meet the ever-increasing needs of the district, although it was originally believed that the scheme would serve all domestic and other needs for more than thirty years. The Admiralty, however, are already demanding their full complement. So far as can be learned, the District Committee do not intend to enlarge their present works at Glenguey, because even an extension there would be absolutely inadequate to cope with the anticipated wants of the district. Under statutory obligation, the District Committee must supply the extended area of the burgh of Dunfermline; and it is evident that they intend to forsake none of their powers. Accordingly, they have been prospecting in the only source now available within a wide radius—that is, the clear winding Devon, from which, by damming it at a point considerably to the north-west of Glensherup, they anticipate they will be able to afford a daily delivery of 12 million gallons. It is not at all likely that the Town Council of Dunfermline will submissively acquiesce in the scheme, because they must see that the new territory will not be unduly burdened by rates. Therefore it is believed they will offer a strenuous fight in order to secure terms for the new community which is to grow up under their care—if, indeed, they have no other grounds for opposition. At a reasonable estimate, it may be expected that such a scheme as has latterly been proposed may cost anything up to £500,000. On Tuesday last, the District Committee resolved to "harness" the River Devon in order to augment their water supply; and on Friday, the Town Council unanimously resolved to promote a Provisional Order or Private Bill for powers to obtain a supply of water from the Devon, and to transfer the portion of the area which is included in the compulsory water area of the Dunfermline District Committee from the jurisdiction of the District Committee to that of the Town Council.

**Kirkcaldy.**—On Friday, the Auditor of the Court of Session dealt with the remit to fix the Liquidator's fees; and he also taxed the law accounts connected with the arbitration. The Auditor fixed the Liquidator's fees at £1050, which is the same amount as that proposed by the Liquidator. The result of the taxation of the business account is to leave the total amount substantially unchanged.

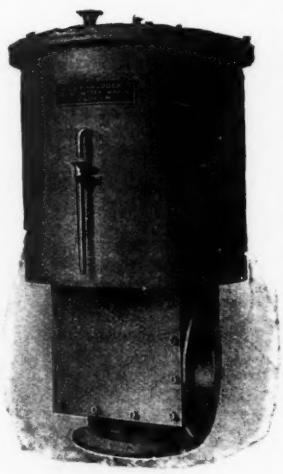
**Perth.**—A breakdown has occurred in the old retort-benches at the gas-works; and a special meeting of the Town Council was held on Monday to consider the situation. Mr. David Vass, the Gas Engineer, submitted to the Council a report in which he explained that the ovens were showing signs of decay. Very poor results were being obtained; and there was reason to fear a further falling-in. He impressed upon the Council the necessity of making immediate provision to replace their reserve by filling-in the four arches which are at present vacant; and he asked authority, as a matter of urgency, to obtain tenders for the work. The first cost of filling-in a vacant arch would be a capital charge; and he estimated the cost of filling-in the four vacant arches at £2800. Mr. Vass also recommended that he be empowered to purchase a class of coal which would yield high results in make of gas to carry them through the period till the reserve retorts were ready for action. The Council, on the motion of Bailie Calderwood, agreed to give effect to the proposals of the Engineer.

**Price of Gas in the Aldershot District.**—In the paragraph on the subject of the reduction in the price of gas by the Aldershot Gas, Water, and District Lighting Company in the "JOURNAL" last week (p. 461), the parish of Tongham was included in the (*a*) area. The General Manager and Secretary of the Company (Mr. R. W. Edwards) writes to point out that though this is correct in so far as the parish is included in the administration of the (*a*) area, it is, according to Statute, in the (*b*) area; and therefore the price of gas applicable to the latter area (3s. and 2s. 8d.) is charged in Tongham.


BRADDOCK'S

RETORT-HOUSE

GOVERNORS.



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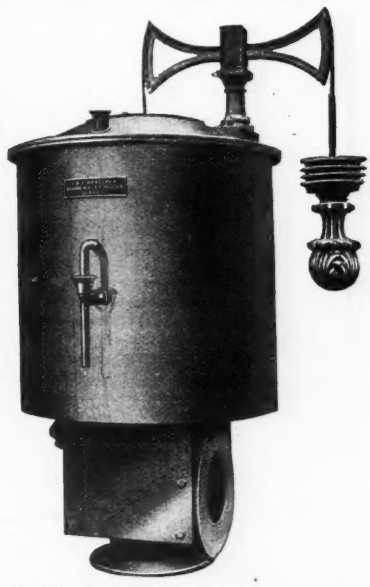
Braddock's Enclosed Retort-House Governor, with Internal Float.

SECOND TO NONE.

For Efficiency and Reliability.

Many Repeat Orders have been received.



No. 244. Braddock's Enclosed Retort-House Governor, Beam Type

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## CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 9.

**Sulphate of Ammonia.**

In the early part of the week there was some increase in the demand, which brought about a slight improvement in values; but during the last day or two the market for this material has again become dull, and prices have once more receded to the level of last week. The exports for last month from the United Kingdom are nearly 5000 tons less than those for October, 1911. At the close, the quotations are £13 17s. 6d. per ton f.o.b. Hull, £13 18s. 9d. per ton f.o.b. Liverpool, and £14 per ton f.o.b. Leith. Some manufacturers have now modified their views in the forward position, and it is reported that several first-hand transactions have taken place below £14 10s. per ton f.o.b. at the best ports for delivery during the first half of next year. The volume of business has, however, not been large, as only a limited interest has been shown over this period.

**Nitrate of Soda.**

This market is very steady at 11s. 9d. per cwt. for ordinary and 11s. 10½d. for refined quality, on spot.

LONDON, *Nov.* 11.

**Tar Products.**

There is little alteration in the market for tar products, though on the whole prices remain steady; but business is somewhat quiet. Sales are reported in pitch at still further lower figures, both for prompt and forward delivery, and consumers expect a further reduction. In benzol, sales are reported at lower prices. To some extent this is accounted for by the very heavy production at the present moment, and stocks are reported to be accumulating. Solvent and heavy naphthas are firm, and prices remain about the same. Creosote maintains its price, and the demand continues. Crude carbolic is without alteration.

The average values during the week were: Tar, 27s. 3d. to 31s. 3d. Pitch, London, 44s. to 45s.; east coast, 44s. to 44s. 6d.; west coast, Clyde, 44s. to 45s.; Manchester, 43s. 6d. to 44s.; Liverpool, 43s. 6d. to 44s. 6d. Benzol, 90 per cent., naked, London, 11½d.; North, 10½d.; 50-90 per cent., naked, London, 11d.; North, 10⅜d. to 11d. Toluol, naked, London, 11½d. to 1s.; North, 11d. to 11½d. Crude naphtha, in bulk, London, 5⅝d. to 5¾d.; North, 5d. to 5⅛d. Solvent naphtha, naked, London, 1s. 1½d. to 1s. 2d.; North, 1s. 1⅜d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10½d. to 11d. f.o.b. Creosote, in bulk, London, 3½d. to 3¾d.; North, 3d. to 3¼d. Heavy oils, in bulk, 3⅜d. to 3½d. Carbolic acid, casks included, 60 per cent., east coast, 1s. 11d. to 2s.; west coast, 1s. 10½d. to 1s. 11d. Naphthalene, £5 to £9; salts, 45s. to 50s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

**Sulphate of Ammonia.**

There is still no improvement in this article; and the tender parcels appear to have been meeting the fresh prompt orders. Sales are reported over next year at very reasonable prices, and considerably under those which are asked by manufacturers at the present moment. Outside London makes are £13 16s. 3d.; Hull, £13 18s. 9d.; Liverpool, £13 18s. 9d.; Leith, £14 to £14 1s. 3d.; Middlesbrough, £13 18s. 9d.

## COAL TRADE REPORTS.

**Northern Coal Trade.**

There is a steady tone in the northern coal market; and prices are well maintained generally. In the steam coal trade, best Northumbrians are from 14s. per ton f.o.b., second-class steams are from 12s. 6d. to 13s., and steam smalls about 9s 9d. to 11s. The production at the collieries is good; and it is well taken up, though this is a season when usually the closing of the Baltic lessens the shipments. In the gas coal trade, prices are firm, with a full consumption. Best Durhams are 15s. per ton f.o.b.; second-class gas coals are from 14s. to 14s. 6d.; and "Wear specials" are about 15s. 9d. The contracts include 120,000 tons for Stockholm, at 19s. 9d. to 20s. per ton delivered for Gefle; and about 6500 tons at near 21s. per ton, for "special" sorts, delivered. There have been also contracts for part of the supply for the Trieste Gas-Works; but the details are not yet officially made known. Other smaller contracts are in course of negotiation; but the above figures for current prices are likely to be near the mark for these contracts. Where, however, there are to be added sea freights, the delivered value for next year promises to be a high one; the price of coals and the rate of freights being higher, and this to some extent. Coke is very firm. Good gas coke is now raised to 23s. 6d. per ton f.o.b. in the Tyne or Wear.

**Scotch Coal Trade.**

The coal trade throughout Scotland is fairly active in all departments, and prices rule steady. On Friday, on the Glasgow Coal Exchange, the prices quoted f.o.b Glasgow were: Steam coal, 11s. 6d. to 12s.; splint, 14s to 14s. 6d.; ell, 12s. 6d. to 12s. 9d.; trebles, 13s. to 13s. 6d.; doubles, 12s. 6d. to 13s.; and singles, 12s. to 12s. 6d.

**Higher Prices for Gas Coals.**

Under this heading, the following remarks appeared in the "Newcastle Daily Chronicle" last Tuesday: "Particulars were received on Newcastle Exchange yesterday of the allotment of the Stockholm Gas Company's coal contract for next year. The quantity required is about 120,000 tons of gas coals, and 54,000 tons of steam smalls—the latter for the electrical works. The Company have bought the usual quantity of Old Pelton gas coal—some 80,000 to 90,000 tons—at 19s. 9d., c.i.f., which, allowing about 6s. 6d. for the freight to Stockholm, leaves


# THE PIONEERS OF THE SLOT METER.

FIRST IN 1889.

FOREMOST 1912.

### THE INTRODUCTION OF THE SLOT METER.

WRITING to supplement the information given in our "Questions and Answers" column last week with regard to the introduction of the slot meter, a correspondent says that the first patentee was Mr. W. Brownhill, but his meter was never in practical use. The first Gas Company to supply gas in quantity through slot meters was the Liverpool United Gas Company. They supplied gas in bulk to the Corporation for the artisans' dwellings in Casino Street, Liverpool. The Corporation fixed 50 penny-in-the-slot meters in these dwellings. The meters were Thorp and Marsh's patent, and they were manufactured by Messrs. Sawer and Purves. The meters were fixed for six months on approval, at the end of which time the Corporation had to decide whether they were a success or failure. Mr. Marsh entered into a guarantee that the meters should be satisfactory, and he undertook liability for any accident that might occur. Our correspondent adds that he has no hesitation in saying that Sir George Livesey was the first man controlling a gas undertaking to strenuously advocate the use of the slot meter.

GAS v. ELECTRICITY

(From the GAS WORLD.)

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13s. 3d. per ton for the coal. They have also purchased about 20,000 tons of Thornley and Easington gas coal, at a c.i.f. price which leaves about 14s. 3d. as the free-on-board price, and 10,000 tons of Holmside gas coal at 19s. 11d. c.i.f., which is estimated to leave about 13s. 6d. for the coal. The electric works order has been divided between Lambton smalls and Scotch peas and beans; 20,000 tons being taken of the former, and 24,000 tons of the latter. The price of the smalls has not transpired, but may be gathered from the fact that D.C.B. (Blyth) smalls were offered at from 16s. 5d. to 17s. c.i.f., and were declined. The Stockholm Company bought the coals which are being delivered on the present contract in May, directly after the strike; but, compared with even the inflated prices of that period, the prices of the latest contract are from 1s. to 1s. 6d. higher. Compared with the prices current a year ago, they are more than 4s. a ton higher. A fair idea may thus be gained of the strength of next year's coal market."

## Sale of Stocks and Shares.

The sale conducted by Messrs. A. & W. Richards at the Mart, Tokenhouse Yard, E.C., last Tuesday, included two new issues of capital by order of Directors. The first lots consisted of £5000 of 5 per cent. ordinary stock, £4250 of 5 per cent. preference stock, and £2000 of 4 per cent. perpetual debenture stock of the South Essex Water-Works Company. The ordinary stock, which is now carrying its full dividend, was all sold at £115 to £115 10s. per £100; the preference stock fetched £122 10s. per £100; and the debenture stock was placed at from par to £100 10s. Next came a new issue of £10 "B" shares in the Grays and Tilbury Gas Company. These shares rank for a standard dividend of 7 per cent.; but that last paid was at the rate of £5 19s. per cent. per annum They were all sold at £11 2s. 6d. to £11 5s. each. A small parcel of £10 "B" shares in the Tendring Hundred Water Company, ranking for a maximum dividend of 8 per cent., but carrying 4½ per cent. (the rate paid for the last six years), fetched £10 17s. 6d. to £11 each.

**Chorley Water Supply.**—Terms of settlement have been definitely arranged of an old-standing dispute between the Corporations of Chorley and Liverpool in regard to the water supply of the former town. When Liverpool constructed reservoirs in the Rivington district some sixty years ago, they took over the existing Chorley reservoir, and arrangements were then come to in regard to the town receiving a domestic supply in the future. For the past few years, the Chorley Corporation have, it appears, had much fault to find with the terms on which water was supplied, and at one stage litigation was threatened. An amicable arrangement has, however, been arrived at whereby the town is to be provided with a sufficient supply for all purposes at a price which will, it is believed, compare favourably with other districts.

## Malvern Gas Undertaking.

In his report on the accounts of the Malvern Urban District Council for the year to March 31 last, the District Auditor stated that the decrease in the profit of the gas undertaking amounted to £1163. This was apparently accounted for by the charge of £400, paid for the redemption of gas debentures, which had since been recouped to the extent of £359 by the sale of sinking fund securities; a sum of £333 charged to the account for the purchase of additional land; and a decrease of about £400 in the receipts. The Council were informed that a letter had been received from the Local Government Board with regard to the amount of the total arrears of income outstanding at March 31. The Clerk said he had replied that the arrears appeared to be about £108 in excess of the previous year. No special reason could be given for the increase, as it was not confined to one account. It had been found practically impossible to reduce the arrears much below this amount, without taking extreme measures for the recovery of sums outstanding. The Council had, therefore, decided this year to give a discount to all gas consumers who paid their account within 28 days from the delivery of the demand note, and hoped that by this means the arrears would be reduced in future. At all events, the returns up to the present showed a decided improvement.

**Snaith Water Supply.**—A Local Government Board inquiry was held at Snaith last Friday, relative to a supply of water for that parish. Mr. John Fazakerley, the Gas and Water Engineer to the Goole Urban District Council, submitted plans and estimates of the cost of the proposed work, and they were approved. Mr. Fazakerley, who is the Engineer for the work, promised the Inspector to proceed with it without delay.

**Calcutta Public Lighting.**—In connection with the new Calcutta public lighting contract, Messrs. Mansfield and Sons, Limited, of Birkenhead, have supplied 11,000 of their burners to the Corporation. In this type of burner, the nipple, injector, and nozzle are interchangeable, so that with the same body the purchasers can make up a burner which will consume efficiently any given quantity of gas. The burners (which are now working, and are stated to be giving the greatest satisfaction) are arranged in different powers. Some consume 3 6 cubic feet of gas per hour, and others as low as 2 cubic feet, for the narrow lanes. Laboratory tests, we are informed, show that they are giving an efficiency of about 25 candles per cubic foot of gas. The contract, it may be pointed out, provides for gas being paid for by the consumption of the various sizes of nipples used in different parts of the town. In connection with the same contract, the order for 1750 public lamps (750 of which are for double burners) has been placed with Messrs. S. Pontifex and Co., of Regnart Buildings, N.W.; the pattern selected being specially constructed to withstand the tropical rains, and also being insect proof. The order carries with it 1500 glass tablets for street names, and the incidental wrought-iron work.

Gas Plant and all constructional Steel and Iron Work.

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**Price of Gas in Johannesburg.**—Within the past three years, the price of gas in Johannesburg has been reduced 60 per cent. At the beginning of 1910, the Council lowered it from 15s. per 1000 cubic feet for lighting and 12s. for cooking to an all-round price of 7s. 6d.; and following this reduction, the sale rose from 12,771,400 cubic feet in 1908-9 to about 23,500,000 cubic feet in 1911-12. The largely increased consumption and the fall in the price of coal have induced the Gas Department of the Corporation to recommend a further reduction to 6s. per 1000 cubic feet. With regard to the prepayment consumers, who have recently been paying 10s. per 1000 cubic feet, the proposal is to reduce the figure to 8s. 4d. Hitherto meter-rentals ranging from 1s. to 5s. per month have been charged; but the Council have been recommended not to charge consumers using a reasonable quantity of gas, varying according to the size of the meter.

**Ticehurst Rural District Council and the Water-Works.**—The Clerk to the Ticehurst Rural District Council (Mr. J. C. Lane Andrews) reported, at last Thursday's meeting, that he had interviewed Mr. Jarvis, the Solicitor to the Ticehurst and District Water and Gas Company, with reference to the correspondence which had taken place in regard to the water-works; the Council having received an offer from the Company to sell the undertaking. Mr. Jarvis stated that negotiations were in progress with several gentlemen in the neighbourhood, with a view to their taking over the concern. He (the Clerk) pointed out that a great deal of time would be occupied before the Council decided on the matter, and he would leave it to Mr. Jarvis to do what he thought best. A member mentioned that he had received a letter inviting him to co-operate with a syndicate to take over the water-works as a whole. He understood that the proposal was to purchase the undertaking, excluding the gas portion, and to increase the supply of water by making another well.

**Slough Gas Company.**—At the recent half-yearly meeting of this Company, the accounts presented showed a profit of £2230. In moving the adoption of the report and accounts, the Chairman (Mr. J. Herbert) said the increase in the sale of gas equalled 6½ per cent. A reduction of 2d. per 1000 cubic feet had been made in the price, and when this had been in operation twelve months the dividend on the original shares would be 12 per cent. and on the new ordinary shares £8 8s. per cent. per annum. The reduction in price to consumers cost £460, and the increase in dividend would amount to £156; making a total of £616. The motion was carried. Questions upon the accounts elicited the statement that the Company now make 68 million cubic feet of gas per annum, of which about 10 per cent. is unaccounted for. It was suggested that this should be printed in the accounts, so that the shareholders could check it. Votes of thanks were accorded the Directors, Auditors, and staff, and the ordinary business closed. A special meeting was afterwards held, at which it was decided to apply to Parliament for power to increase the capital of the Company in order to pay for the new gasholder and tank and provide for future extensions of works and mains.

**Water Supply in Brazil.**—The daily supply of drinking water to Rio de Janeiro amounted during last year to about 52,870,000 gallons; and in order to increase the supply, new pipes have been laid from the reservoirs, while the dam across the River Sao Pedro has been raised so as to increase its contribution to one of the reservoirs by about 2 million gallons. In order further to increase the supply, and particularly to guard against the effects of drought, surveys have been made for 136 reservoirs, with a total capacity of more than 110,000 million gallons, and several are actually in course of construction.

**Ammonia Recovery and Gas-Cleaning Plant.**—Messrs. E. G. Appleby and Co. have secured the contract for four 10 feet diameter Kerpely revolving-grate gas producers adapted for ammonia recovery, including all the cleaning plant, sulphate of ammonia recovery plant, and tar dehydrating plant, for dealing with producer gas from 100 tons per day of South Staffordshire slack. The cleaning and scrubbing plant deals with a gas to supply 2000 H.P. gas-engines, and the rest of the gas is utilized for heating the furnaces and for firing boilers at the Birmingham Battery and Metal Company's works at Selly Oak, Birmingham. In the short time that has elapsed since the Kerpely producer was introduced to the English market, we learn that twenty-five producers have been sold to eight works in Great Britain; and of these eight works, five have given repeat orders. In addition, nine Kerpely producers of the largest size are on order at the present time for English works.

## APPLICATIONS FOR LETTERS PATENT.

24,580.—LYNDE, F. C., "Gas-governors." Oct. 28.
24,593.—JAMES, J. M., "Universal joints." Oct. 28.
24,649.—WOOD, G., "Exhausting and compressing gases." Oct. 28.
24,681.—GROVES, H., "Indicating the rate of flow of liquids." Oct. 28.
24,746.—JOLLY, J. B., "Gas-producers." Oct. 29.
24,772.—KENT-JOHNSTON, A. G., "Controlling the lighting and extinguishing of gas-lamps." Oct. 29.
24,780.—HUMPHREY, A. A., "Carburetting air." Oct. 29.
24,790.—YATES, F. E., "Valves for burners." Oct. 29.
24,797.—MORGENSCHWEIS, K., "Gas-generators." Oct. 29.
24,875.—FISCHER, C. H., and ZIMMERMANN, R., "Incandescing bodies." Oct. 30.
25,023.—WARNER, W., "Distilling ammoniacal liquors." Nov. 1.
25,075.—HILL, J. K., "Liquid meters." Nov. 1.
25,080.—RICHES, H. R., "Manufacture of fuel." Nov. 1.
25,098.—SMITH, H. E., "Petrol gas apparatus." Nov. 1.
25,147.—MITCHELL, E. A., "Governors." Nov. 2.
25,163.—WESTERBERG, P. A., "Stop valves." Nov. 2.
25,165.—ROSENBERG, A., "Producing combustible gaseous mixtures." Nov. 2.


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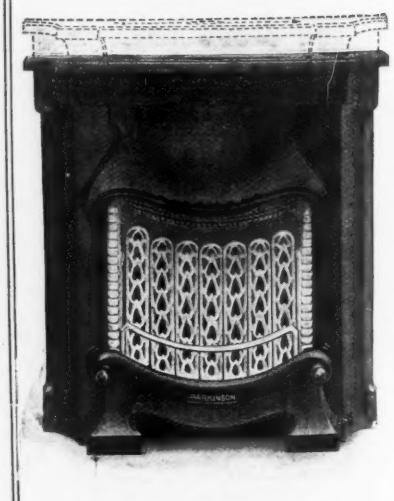

THE "ELYSIAN,"
**Showing Adjustable Cornice.**

The South Metropolitan Gas Company have just opened a showroom and office in Nelson Street, Greenwich. It is on the same plan as their establishment in High Street, Lewisham; and both places being in direct telephonic communication with the head office, there is no need for any consumer in the Greenwich or Lewisham district to make a journey to the Old Kent Road to transact business.

Mr. E. Brough Taylor, M.Inst.C.E., a member of the firm of Messrs. John Taylor, Sons, and Santo Crimp, has been appointed by the Sandown Urban District Council to prepare the particulars usually required by the Local Government Board relative to the proposed purchase of the Isle of Wight Water-Works by the Council. They will nclude an estimate of the financial position of the Council, should they acquire a portion or the whole of the undertaking.

At the meeting of the Cuckfield Urban District Council last Thursday, the Surveyor (Mr. Albert Croucher) presented a detailed report upon the question of automatic lighting of the public lamps in the town. He said there would be an initial outlay upon controllers, service-pipes, &c., of upwards of £100; but the estimated cost of lighting would be reduced from £46 10s. to £26 10s. The report was referred to a Committee; but the Council will not do anything in the matter until the new financial year.

Alluding to the paragraph that appeared in the "JOURNAL" last week (p. 464), Messrs. Falk, Stadelmann, and Company, Limited, desire, through the medium of our columns, to acknowledge the number of sympathetic messages they have received in connection with the fire which occurred last Sunday week at their premises in Great Saffron Hill. While the damage to the building involved was very considerable, they state that the bulk of their warehouses are intact. They are, therefore, in a position to carry on business without any interruption, and are quite able to cope with all orders as received.

Speaking at a dinner of the Society of Motor Manufacturers and Traders held at the Savoy Hotel last Wednesday, Mr. A. Stanley, M.P., Chairman of the Royal Automobile Club, expressed the belief that the rise in the price of fuel was due almost entirely to the enormous increase in the demand; and he said he had personally been conducting an inquiry into the matter. The one thing which they ought to set themselves to do was to find other fuel, which, if it could not take the place of petrol, could at least supplement it. The President (Mr. E. Manville), in responding, said he hoped and believed that the Society would devote some of its funds towards the establishment of a prize to the inventor of a practicable fuel.

There was recently opened at the Diamond Foundry, Luton, a new institute, which has been erected on a corner of the land of the Davis Gas-Stove Company, for the use of members of the Davis Athletic and Social Club. The club is quite a new one; but the numerous sections have all become exceedingly popular. Though the Directors are anxious to give every encouragement in their power to the movement, the club is to be managed by the men themselves, and the idea is that it shall be self-supporting. The opening function was presided over by Mr. H. Addis-Price, the new Chairman of the Company; and the proceedings consisted of short speeches, a prize distribution, and musical interludes. The outer door of the club was to have been unlocked by Master Kenneth Davis, the son of Mr. H. N. Davis, the Managing-Director of the Company; but wet weather made this impossible. The key which was to have been used was, however, presented to Master Davis by Mr. Peter Murdoch, the Chairman of the Executive Committee. The building is 80 feet by 30 feet. The larger portion is taken up by the main hall, 50 feet by 30 feet, which is provided with a billiard table, and also equipped for use as a gymnasium and for a variety of other amusements. The total membership of the club is already over 400.

## GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange had a better time last week almost up to the close. There were some spurts of activity which made things livelier, coupled with some cheering factors. The termination at last of the long, lingering throes of the election in the United States gave a fine fillip to the American Market; and Mr. Asquith's announcement that the Government would redeem their promise to the Railway Companies strengthened that market, though it got a little shaky again later on. The gilt-edged division found support, and Consols were firm. The opening, however, was rather dull and inanimate, and prices drooped. But the afternoon brought some recovery; so that the close saw little change. Tuesday was quiet; but the tone was fair, cheered by a more healthy appearance in the Bourse. Leading markets, except Rails, were firm. Business was brisker on Wednesday, with some good points. Government issues were very firm, and Consols jumped up ⅜. Americans rose; and the Foreign Market saw peace looming ahead. Rails, however, were queer. On Thursday, things were still fairly active; and the cheerful tendency was maintained. Markets in general showed strength; and Rails, though mixed, had more ups than downs. Friday was scarcely so down, but not quite so satisfied with Balkan news. But gilt-edged were steady; and Rails had their rise. Americans were affected by profit realizations. Saturday was a prey to anxiety increasing as the Bulgarian army draws nearer to Constantinople; and the question whether the winners are to take the stakes has to be answered. Prices in general were put down in all markets; but business was very quiet—as usual on Lord Mayor's Day. Consols lost ⅛, closing at 73⅞ to 74⅛, and showing a net gain of ⅛ in the week. In the Money Market, there was an ample supply to meet all requirements, and rates became easier. Business in the Gas Market was much more active than of late; and some of the old favourites quite shook off their autumn lethargy and became prominent to view again. The general characteristic can only be described as marked steadiness; for only one issue throughout the whole list underwent any change. In Gaslight and Coke, the ordinary was fairly active daily; and all transactions were within the close limits of 102¼ to 103. The secured issues were more active. The maximum was done at 82½ and 83, the preference at 100¼ to 101½, and the debenture at 76½ to 77¾. South Metropolitan was quite busy, and was very firm at 116¼ to 117¼. In Commercials, there were two bargains in the 4 per cent. at 106¾ and 107¼. Among the Suburban and Provincial group, Alliance and Dublin realized 78½, Brentford debenture 97, Bournemouth preference 14⅜, British 44⅛, South Suburban 118½ and 119¼ (a fall of 1), Tottenham "B" 115½, and ditto debenture 95½. In the Continental companies, Imperial changed hands at 182 and 183, Union at 81⅞ and 83, and European at 19¼ and 19½. Among the undertakings of the remoter world, Bombay was marked at 6 7/16 and 6⅝, Monte Video at 11⅜, Primitiva at 6¾ to 6 15/16, and ditto preference at 5 to 5 3/16.

| Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. | Rise or Fall in Wk. | Yield upon Investment. |
|---|---|---|---|---|---|---|---|
| £ | | | p.c. | | | | £ s. d. |
| 1,551,868 | Stk. | Oct. 11 | 5 | Alliance & Dublin Ord. | 76—81 | .. | 6 3 5 |
| 374,000 | Stk. | July 12 | 4 | Do. 4 p.c. Deb. | 89—91 | .. | 4 7 11 |
| 250,000 | 5 | Oct. 11 | 7½ | Bombay, Ltd. | 6⅜—6⅞ | .. | 5 9 1 |
| 50,000 | 10 | Aug. 29 | 15 | Bourne- ) 10 p.c. | 28—29 | .. | 5 3 5 |
| 332,000 | 10 | ,, | 7 | mouth Gas ) B 7 p.c. | 15⅜—16¼ | .. | 4 6 2 |
| 75,000 | 10 | ,, | 6 | and Water ) Pref. 6 p.c. | 14—14½ | .. | 4 2 9 |
| 380,000 | Stk. | Aug. 14 | 13½ | Brentford Consolidated | 257—262 | .. | 5 3 1 |
| 330,000 | ,, | ,, | 10½ | Do. New | 197—202 | .. | 5 4 0 |
| 50,000 | ,, | ,, | 5 | Do. 5 p.c. Pref. | 116—118 | .. | 4 4 9 |
| 206,250 | ,, | June 14 | 4 | Do. 4 p.c. Deb. | 96—98 | .. | 4 1 8 |
| 218,230 | Stk. | Aug. 29 | 11 | Brighton & Hove Orig. | 210—215 | .. | 5 2 4 |
| 244,200 | ,, | ,, | 8 | Do. A Ord. Stk. | 152—155 | .. | 5 3 3 |
| 530,000 | 20 | Sept. 27 | 12½ | British | 44—45 | .. | 5 11 1 |
| 120,000 | Stk. | June 28 | 4 | Do. 4 p.c. Deb. Stk. | 91—93 | .. | 4 6 0 |
| 245,771 | Stk. | June 28 | 4 | Buenos Ayres 4 p.c. Deb. | 93—95 | .. | 4 4 3 |
| 100,000 | 10 | — | — | Cape Town & Dis., Ltd. | 2—3 | .. | — |
| 100,000 | 10 | — | — | Do. 4½ p.c. Pref. | 3½—4½ | .. | — |
| 100,000 | Stk. | June 28 | 4½ | Do. 4½ p.c. Deb. Stk. | 70—73 | .. | 6 3 3 |
| 157,150 | Stk. | Aug. 29 | 5 | Chester 5 p.c. Ord. | 110—112 | .. | 4 9 3 |
| 1,513,280 | Stk. | Aug. 29 | 5/9/4 | Commercial 4 p.c. Stk. | 106—108 | .. | 5 1 2 |
| 560,000 | ,, | ,, | 5⅓ | Do. 3½ p.c. do. | 101—103 | .. | 5 3 6 |
| 475,000 | ,, | June 14 | 3 | Do. 3 p.c. Deb. Stk. | 73—75 | .. | 4 0 0 |
| 800,000 | Stk. | May 31 | 4 | Continental Union, Ltd. | 80—83 | .. | 4 16 5 |
| 200,000 | ,, | ,, | 7 | Do. 7 p.c. Pref. | 133—135 | .. | 5 3 8 |
| 492,270 | Stk. | — | 5⅝ | Derby Con. Stk. | 124—125 | .. | 4 12 0 |
| 55,000 | ,, | — | 4 | Do. Deb. Stk. | 103—105 | .. | 3 16 2 |
| 1,002,180 | 10 | July 26 | 10 | European, Ltd. | 19—20 | .. | 5 0 0 |
| 16,160,600 | Stk. | Aug. 14 | 4/17/4 | Gas- ) 4 p.c. Ord. | 101½—103½ | .. | 4 14 1 |
| 2,600,000 | ,, | ,, | 3½ | light ) 3½ p.c. max. | 81—84 | .. | 4 3 4 |
| 4,062,235 | ,, | ,, | 4 | and ) 4 p.c. Con. Pref. | 99½—101½ | .. | 3 18 10 |
| 4,531,705 | ,, | June 14 | 3 | Coke ) 3 p.c. Con. Deb. | 76—78 | .. | 3 16 11 |
| 258,740 | Stk. | Sept. 13 | 5 | Hastings & St. L. 3½ p.c. | 91—93 | .. | 5 7 6 |
| 82,500 | ,, | ,, | 6½ | Do. do. 5 p.c. | — | .. | — |
| 70,000 | 10 | Oct. 11 | 11 | Hongkong & China, Ltd. | 16—16½ | .. | 6 13 4 |
| 131,000 | Stk. | Sept. 13 | 7⅜ | Ilford A and C | 154—157 | .. | 4 17 1 |
| 65,780 | ,, | ,, | 6½ | Do. B | 121—123 | .. | 4 19 7 |
| 65,500 | ,, | June 28 | 4 | Do. 4 p.c. Deb. | 91—93 | .. | 4 6 0 |
| 4,940,060 | Stk. | May 15 | 9 | Imperial Continental | 180—185 | .. | 4 17 3 |
| 1,235,000 | Stk. | Aug. 14 | 3½ | Do. 3½ p.c. Deb. Red. | 86—88 | .. | 3 19 7 |
| 200,242 | Stk. | Aug. 29 | 6 | Lea Bridge Ord. 5 p.c. | 122—125 | .. | 4 16 0 |
| £ | | | p.c. | | | | £ s. d. |
| 561,000 | Stk. | Aug. 29 | 10 | Liverpool United A. | 216—218 | .. | 4 11 9 |
| 718,100 | ,, | ,, | 7 | Do. B. | 155½—157½ | .. | 4 8 11 |
| 306,083 | ,, | June 28 | 4 | Do. Deb. Stk. | 100—102 | .. | 3 18 5 |
| 63,480 | Stk. | June 28 | 3 | Maidstone 3 p.c. Deb. | 69—71 | .. | 4 4 6 |
| 75,000 | 5 | June 14 | 6 | Malta & Mediterranean | 4⅜—4⅝ | .. | 6 3 1 |
| 250,000 | 100 | Oct. 1 | 4½ | Met. of Melbourne ) 4½ p.c. Deb. | 99—101 | .. | 4 9 1 |
| 541,920 | 20 | Oct. 30 | 3½ | Monte Video, Ltd. | 11¼—11⅜* | .. | 5 19 2 |
| 1,775,892 | Stk. | July 26 | 4½ | Newc'tle&G'tesh'd Con. | 99—100 | .. | 4 7 6 |
| 529,705 | Stk. | June 28 | 3½ | Do. 3½ p.c. Deb. | 85—86 | .. | 4 1 5 |
| 55,940 | 10 | Aug. 29 | 7/7/0 | North Middlesex 7 p.c. | 133—133 | .. | 5 1 5 |
| 300,000 | Stk. | May 15 | 8 | Oriental, Ltd. | 13⅛—14½ | .. | 6 0 4 |
| 60,000 | 5 | Sept. 27 | 10 | Ottoman, Ltd. | 8⅛—8⅜ | .. | 5 14 3 |
| 60,000 | 50 | Aug. 14 | 13 | Portsea Island B | 127—130 | .. | 5 0 0 |
| 100,000 | 50 | ,, | 12 | Do. C | 124—127 | .. | 4 14 6 |
| 249,980 | 5 | Oct. 11 | 8 | Primitiva Ord. | 6⅜—7 | .. | 5 14 4 |
| 499,960 | 5 | June 28 | 5 | Do. 5 p.c. Pref. | 5—5¼ | .. | 4 15 3 |
| 521,600 | 100 | June 1 | 4 | Do. 4 p.c. Deb. | 96—98 | .. | 4 1 8 |
| 346,198 | Stk. | June 28 | 4 | River Plate 4 p.c. Deb. | 93—95 | .. | 4 4 3 |
| 275,000 | 5 | Apl. 12 | 12 | San Paulo, Ltd. | 13—14 | .. | 4 5 9 |
| 150,000 | 10 | Sept. 27 | 6 | Do. 6 p.c. Pref. | 11⅛—12 | .. | 5 0 0 |
| 125,000 | 50 | July 1 | 5 | Do. 5 p.c. Deb. | 49—51 | .. | 4 18 0 |
| 135,000 | Stk. | Aug. 29 | 10 | Sheffield A | 230—232 | .. | 4 6 2 |
| 209,984 | ,, | ,, | 10 | Do. B | 229—231 | .. | 4 6 7 |
| 523,500 | ,, | ,, | 10 | Do. C | 229—231 | .. | 4 6 7 |
| 90,000 | 10 | Sept. 27 | 7½ | South African | 9—10 | .. | 7 10 0 |
| 6,429,895 | Stk. | Aug. 29 | 5/9/4 | South Met., 4 p.c. Ord. | 116—118 | .. | 4 12 8 |
| 1,895,445 | ,, | July 12 | 3 | Do. 3 p.c. Deb. | 76—79 | .. | 3 15 11 |
| 209,820 | Stk. | Aug. 14 | 8½ | South Shields Con. Stk. | 163—165 | .. | 5 3 0 |
| 605,000 | Stk. | Aug. 14 | 5/16/8 | S'th Suburb'n Ord. 5 p.c. | 117—119 | −1 | 4 17 11 |
| 60,000 | ,, | ,, | 5 | Do. 5 p.c. Pref. | 117—119 | .. | 4 4 0 |
| 117,058 | ,, | July 12 | 5 | Do. 5 p.c. Deb. Stk. | 120—122 | .. | 4 2 0 |
| 594,740 | Stk. | May 15 | 5 | Southampton Ord. | 105—107 | .. | 4 13 6 |
| 120,000 | Stk. | Aug. 14 | 7½ | Tottenham ) A 5 p.c. | 142—145 | .. | 5 0 0 |
| 483,940 | ,, | ,, | 5⅞ | and ) B 3½ p.c. | 114—116 | .. | 4 19 2 |
| 149,470 | ,, | June 28 | 4 | Edmonton ) 4 p.c. Deb. | 94—96 | .. | 4 3 4 |
| 182,380 | 10 | June 15 | 5 | Tuscan, Ltd. | 8⅛—8⅝ | .. | 5 15 11 |
| 149,900 | 10 | July 1 | 5 | Do. 5 p.c. Deb. Red. | 97—99 | .. | 5 1 0 |
| 236,476 | Stk. | Aug. 14 | 5 | Tynemouth, 5 p.c. max. | 115—115½ | .. | 4 6 7 |
| 255,636 | Stk. | Aug. 29 | 6⅞ | Wands- ) B 3½ p.c. | 133—141 | .. | 4 17 6 |
| 85,766 | ,, | June 28 | 3 | worth ) 3 p.c. Deb. Stk. | 70—72 | .. | 4 3 4 |

Prices Marked * are "Ex. Div."

## WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

**Appointments, &c., Vacant.**

ASSISTANT SUPERINTENDENT OF MAINS AND DISTRIBUTION. Leeds Gas Department. Applications by Nov. 23.
ASSISTANT TO ENGINEER AND MANAGER. No. 5653.
DRAUGHTSMAN. No. 5650.
WORKS ASSISTANT. No. 5651. Applications by Nov. 14.
LABORATORY ASSISTANT. No. 5654.
WORKING MANAGER. Knighton Gas-Works.
FOREMAN SUPERVISOR AND HEAD GAS-FITTER. Calcutta Corporation. Applications by Dec. 15.
CHARGE OF SHOW-ROOM. Newport (I.W.) Gas-Works.
CLERK AND COLLECTOR. Bexhill Water and Gas Company.
BURNER MAINTENANCE AND SLOT-METER COLLECTING. Epsom Gas Company.
RETORT SETTER. Firth Blakeley, Sons, and Co., Limited, Dewsbury.
GAS FITTERS. No. 5647.
STOKER. Dinnington Gas-Works.
FITTER-COLLECTOR. Dinnington Gas-Works.
WORKING FOREMAN. Brymbo Water Company.

**Meeting.**

ORIENTAL GAS COMPANY. Finsbury House, E.C. Nov. 27. Twelve o'clock.

**Patent Licences, &c.**

GAS FROM LIQUID HYDROCARBONS. Haseltine, Lake, and Co., 7 & 8, Southampton Buildings, W.C.
GAS METERS. Geo. Barker and Brettell, 77, Colmore Row, Birmingham.

**Plant, &c. (Second-Hand), for Sale.**

CAST-IRON PIPES. Wills and Packham, Sittingbourne.

**Plant (Second-Hand), Wanted.**

WROUGHT-IRON CIRCULAR TANK. Ilminster Gas Co.

**Stocks and Shares.**

EAST GRINSTEAD GAS AND WATER COMPANY. By Auction. London Mart. Dec. 3.
HARROW AND STANMORE GAS COMPANY. By Auction. London Mart. Dec. 3.
HYTHE AND SANDGATE GAS COMPANY. By Auction. London Mart. Nov. 26.

**Stocks and Shares**—*continued.*

KINGSTON-ON-THAMES GAS COMPANY. By Tender. Nov. 27.
LOWESTOFT WATER AND GAS COMPANY. By Auction. London Mart. Nov. 26.
PINNER GAS COMPANY. By Auction. London Mart, Nov. 26.
SOUTH STAFFORDSHIRE WATER COMPANY. Tenders by Dec. 9.
SOUTHEND WATER COMPANY. By Auction. London Mart. Dec. 3.

**TENDERS FOR**

**Benzol.**

BRIDGEWATER COLLIERIES COKE-WORKS. Tenders by Nov. 21.

**Fire-Clay Goods.**

CHORLEY CORPORATION. Tenders by Nov. 19.

**Pipes.**

GOOLE URBAN DISTRICT COUNCIL. Tenders by Nov. 26.

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